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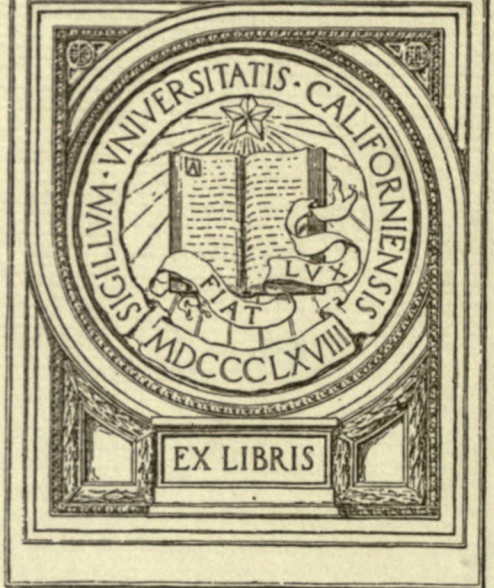
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PUBLICATIONS OF THE YERKES OBSERVATORY

VOLUME IV PART I

STELLAR PARALLAXES DERIVED FROM PHOTOGRAPHS MADE WITH THE FORTY-INCH REFRACTOR

BY

FREDERICK SLOCUM AND S. ALFRED MITCHELL

OLIVER J. LEE AND ALFRED H. JOY

OLIVER J. LEE AND GEORGES VAN BIESBROECK

WITH INTRODUCTORY NOTE

BY EDWIN B. FROST, *Director*

STELLAR PARALLAXES DERIVED FROM PHOTOGRAPHS MADE WITH THE FORTY-INCH REFRACTOR

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Published November 1917

Composed and Printed By
The University of Chicago Press
Chicago, Illinois, U.S.A.

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Univ. of California

INTRODUCTORY NOTE

The successful use of the 40-inch refractor in celestial photography, inaugurated chiefly by George Willis Ritchey, then Assistant Professor of Practical Astronomy at the Yerkes Observatory, increased the desire of Director George E. Hale to employ the telescope for the determination of stellar parallaxes by photography, a plan which he had had in mind for some years. In 1902 Professor Hale took up the matter with Dr. Frank Schlesinger, and when the Carnegie Institution of Washington made a grant to Mr. Hale for the purpose, Mr. Schlesinger began, in May 1903, the preliminary experiments which were necessary to establish a procedure in securing the plates and in laying out a program, in designing a measuring machine and working out a system for the measurement and reduction of the plates. After nearly two years of efficient study of the problem, Dr. Schlesinger was called, in March 1905, to be the Director of the Allegheny Observatory. During that period one quarter of the observing time with the 40-inch telescope was assigned to the program of stellar parallax. Mr. Frank Sullivan, engineer in charge of the 40-inch telescope, assisted Mr. Schlesinger in securing nearly all the plates, and Miss Louise Ware, now of the Mount Wilson Solar Observatory at Pasadena, measured most of the plates in duplicate with Mr. Schlesinger, and after his departure she measured many of them alone.

The importance of the work was appreciated by the writer, and, although funds were not available for continuing a special observer in charge of this work, at least one night a week was assigned for securing parallax plates in the following years until arrangements could be made for the re-establishment of stellar parallax work as a part of the regular program of the Observatory.

The results obtained by Professor Schlesinger were published in a series of seven papers, appearing in the *Astrophysical Journal* as follows: Vol. XXXII (1910), pp. 372–387; Vol. XXXIII (1911), pp. 8–27, 161–184, 234–259, 353–374, 418–430; Vol. XXXIV (1911), pp. 26–36. They were reprinted in a pamphlet of 130 pages, which was distributed in 1911 to institutions and individuals having a special interest in this work. These pamphlets are now out of print. In order to have the present publication include all of the results thus far obtained for stellar parallaxes with the 40-inch telescope up to 1916, it has seemed desirable to include a summary of Dr. Schlesinger's results, as published in the last paper of his series, *Astrophysical Journal*, Vol. XXXIV (1911), pp. 28–29; pp. 122–123 of the reprinted pamphlet. In the summary of results by Messrs. Slocum and Mitchell are also included certain stars for which the details are printed as stated in the footnotes to the summary.

Between 1905 and 1909 the program of stars to be observed was enlarged by the addition of numerous stars to which special attention had been given in the program of the Bruce spectrograph and for which photometric data were also being secured by Mr. J. A. Parkhurst. The plates were secured during this period by Mr. Sullivan; by Mr. Philip Fox, before he left the staff to become Director of the Dearborn Observatory of the Northwestern University at Evanston, Illinois; and by Mr. Frank C. Jordan, then Fellow at the Yerkes Observatory, now Assistant Professor of Astronomy at the Allegheny Observatory. It was not possible during these years to have regular measurements and reductions of these plates made, but it proves to have been of the greatest value that it was possible to keep up, even in a limited way, the observations, as with the lapse of time the establishment of the proper motions has been much more certain. In September 1909 the work was assigned to Dr. Frederick Slocum, who came to the Observatory at that time as Instructor in Astrophysics. In June 1912 it was possible to secure the services of Miss Eudora Magill, who had had much experience in measurements and reductions of stellar photographs at Columbia University, as Computer, and the reductions since that date, up to June 1916, have almost entirely been made by her. For eight months, from August 1911, Dr. Adriaan van Maanen participated in the observations, while Volunteer Research Assistant at the Observatory. During the period from June 1912 to August 1913 Dr. S. Alfred Mitchell, then Assistant Professor at Columbia University, on leave as Re-

search Associate at the Yerkes Observatory, took part in the observations and measurements for stellar parallax.

Upon Professor Slocum's departure, at the end of June 1914, to become Professor of Astronomy at Wesleyan University and Director of the Van Vleck Observatory, this work was assigned to Dr. Oliver J. Lee, Instructor in Practical Astronomy. During the period from October 1, 1914, to July 1, 1915, Professor Alfred H. Joy, of the Syrian Protestant College at Beirut, on leave as Instructor in Practical Astronomy at the Yerkes Observatory, took a regular part in this work; and during the period from September 1, 1915, to June 1916, Dr. Georges Van Biesbroeck of the Royal Observatory, Brussels, on leave as Visiting Professor of Practical Astronomy at the Yerkes Observatory, also participated regularly in the observing and in the measuring of the plates.

The double-slide plate-holder, enlarged for stellar photography with the 40-inch telescope, is illustrated as Plate XII of Vol. II of the *Publications of the Yerkes Observatory;* but, to give a clearer view of its use and of the rotating sector employed for reducing the brightness of the star of which the parallax is sought to equality with the brightness of the comparison star, another photograph was reproduced as Plate XIX in Vol. XXXII of the *Astrophysical Journal.* For the convenience of the reader this illustration is repeated here. It should be mentioned that after July 1916 a new double sector of a design suggested by Mr. Sullivan has been used where the comparison stars are faint. This permits of a reduction of the parallax star by as much as nine magnitudes. The apparatus was described by Mr. Lee in the *Astrophysical Journal*, Vol. XLIV (1916), pp. 59–61. It was not used in obtaining any of the results included in the present publication.

The accidental errors in the determination of these stellar parallaxes will be seen to be quite satisfactorily small, and somewhat improved as time goes on. For those interested in the study of possible systematic errors it is important to have a precise record of the modifications made in the instrumental procedure. It should be noted that a color-filter was not used in the first series of plates obtained as follows: (1) by Schlesinger and Sullivan from May 15, 1903, to March 26, 1905; (2) by Fox and Sullivan from April 1 to August 19, 1905. Otherwise the same color-filter has been used for all observations recorded in this publication.

During a visit to the Observatory at the close of 1914 Professor Kapteyn discussed with us a scheme he had devised for equalizing the intensities of the stellar images on plates taken for determinations of parallax of the bright stars. The plan is described in a note by Kapteyn published in the *Astrophysical Journal*, Vol. XLI (1915), pp. 77–80. A standard plate is taken of the field for the parallax star with the plate out of focus; this plate gives for each star a disk of a degree of blackness depending on the brightness of the star; the plate is then used as an additional filter, or "spot-plate," for the subsequent photographs to be taken of this field. Experiments on this plan were promptly made at the Yerkes Observatory by Mr. Lee, with gratifying results. The plate-holder has been adapted for the additional "spot-plate," but this method was not used for the negatives measured in this Part.

A short bibliography gives the references to the papers concerned with the stellar parallaxes herein summarized.

EDWIN B. FROST

Spring 1917

UNIV. OF CALIFORNIA

PARALLAXES OF FORTY-TWO STARS

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PARALLAXES OF FORTY-TWO STARS

By Frederick Slocum and S. Alfred Mitchell

In the *Astrophysical Journal*, Vol. XXXVIII (1913), p. 1, we published a list of fourteen stellar parallaxes from photographs made with the 40-inch refractor. The method of procedure therein described for exposing and measuring the plates and for reducing the results has been followed in the present series. Summaries of the results of the two series have been published in the *Astronomische Nachrichten*, Vol. CXCVII (1914), p. 81, and Vol. CXCIX (1914), p. 135. Frank R. Sullivan, engineer of the 40-inch telescope, has, as usual, rendered valuable assistance in guiding.

In the column marked "Observers" the abbreviations have the following significance: Sl=Slocum; M=Mitchell; Su=Sullivan; V=A. van Maanen; J=F. C. Jordan, and F=P. Fox.

The plates for thirteen of the stars were measured by Mitchell, all others by Slocum. The computations for all the stars have been made by Miss Eudora Magill.

In the tables and reductions, unless stated to the contrary, all values are in terms of scale divisions. One division of the scale is $\frac{1}{4}$ mm and equals 2″.66. The unit of time for proper motions in the reduction is 100 days. The results in each case are also given in seconds of time per year.

The mean magnitudes of the comparison stars have been estimated on the Harvard scale.

OΣ 547 (0^h0^m, +45°16′)

This is No. 12740 in Burnham's *General Catalogue of Double Stars*. The components are of the same magnitude, 8.3. Burnham calls the north preceding star A and its companion, 4″.7 distant, B.

In the *Astronomische Nachrichten*, Vol. CXCIV (1913), p. 179, R. Furuhjelm called attention to the fact that a star of magnitude 9.5, distant 5′.5 from the OΣ pair, has a proper motion which agrees closely with that of the double star. The double star had already been put upon the parallax program of the 40-inch refractor because of its large proper motion, nearly 0″.9 per year, and the star noted by Furuhjelm is so situated that its parallax can be determined from the same plates. This distant star I have called C.

The same comparison stars, seven in number, were used for the parallax determinations of all three stars.

Six plates were measured by Mr. Slocum.

TABLE 1

Plates of OΣ 547 A, B, and C

No.	Date	Hour Angle	Observers	Quality of Images
1035	1912 Dec. 21	−0h6	Sl, Sl	Good
1036	Dec. 21	−0.2	Sl, Sl	Good
1329	1913 July 26	−0.6	Su, M	Good
1330	July 26	−0.2	Su, M	Good
1434	Nov. 16	−0.2	Su, Sl	Fair
1466	Dec. 21	−0.7	Sl, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence	
				A and B	C
	mm				
1	0.13	−315	+108	+0.117	+0.253
2	.23	−122	−181	.121	.243
3	.12	−105	− 95	.127	.214
4	.13	− 13	+200	.152	.097
5	.27	+128	+167	.165	.043
6	.15	+195	−154	.154	.097
7	.25	+232	− 45	+0.164	+0.053
Parallax star A	.28	+ 22.1	+ 5.4	.....	.....
B	.27	+ 22.1	+ 5.4	.....	.....
C	0.21	− 96.2	− 27.8	.....	.....

The mean magnitude of the comparison stars is approximately 9.8.

TABLE 2

Reductions for OΣ 547 A

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
1035	−0.986	1.0	−0.902	−188	−0.002	0″.00
1036	.982	1.0	− .902	−188	+ .002	+ .01
1329	.733	1.0	+ .778	+ 29	.000	.00
1330	.732	1.0	+ .777	+ 29	+ .001	.00
1434	.713	0.7	− .732	+142	− .022	− .05
1466	−0.654	1.0	−0.902	+177	+ .013	+0.03

TABLE 3

Reductions for OΣ 547 B

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
1035	+0.212	1.0	−0.902	−188	+0.001	0″.00
1036	.211	1.0	− .902	−188	.000	.00
1329	.458	1.0	+ .778	+ 29	− .001	.00
1330	.460	1.0	+ .777	+ 29	+ .001	.00
1434	.502	0.7	− .732	+142	− .010	− .02
1466	+0.544	1.0	−0.902	+177	+ .006	+0.02

The normal equations for A and B are:

			A	B
$5.7c-$	$0.4160\mu-$	$1.6634\pi=$	$-4.5861,$	$+2.2364$
$+11.7814$	$+1.5183$	$=$	$+1.4087,$	$+0.9328$
	$+4.0249$	$=$	$+1.5913,$	-0.4157

from which

	A	B
$c=$	-0.7874	$+0.4081$
$\mu=$	$+0.0870=+0''.231$	$+0.0895=+0''.238$
	$\mu_a=+0^s.080$	$\mu_a=+0^s.082$
$\pi=$	$+0.0371=$	$+0.0316=$
	$+0''.099\pm0''.013$	$+0''.084\pm0''.006$

Probable error corresponding to unit weight,
$\pm0.0088=\pm0''.023$ $\pm0.0041=\pm0''.011$

TABLE 4

REDUCTIONS FOR OΣ 547 C

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
1035....	−0.102	1.0	−0.902	−188	+0.003	+0''.01
1036....	− .107	1.0	− .902	−188	− .002	− .01
1329....	+ .156	1.0	+ .778	+ 29	+ .003	+ .01
1330....	+ .150	1.0	+ .777	+ 29	− .003	− .01
1434....	+ .174	0.7	− .732	+142	− .012	− .03
1466....	+0.216	1.0	−0.902	+177	+0.007	+0.02

The normal equations are:

$5.7c-$	$0.4160\mu-$	$1.6634\pi=$	$+0.4348$
$+11.7814$	$+1.5183$	$=$	$+1.0369$
	$+4.0249$	$=$	$+0.1424$

from which

$c=+0.0949$
$\mu=+0.0859=+0''.229$ $\mu_a=+0^s.079$
$\pi=+0.0422=+0''.112\pm0''.008$

Probable error corresponding to unit weight,
$\pm0.0052=\pm0''.014$

SUMMARY FOR OΣ 547

A $\pi=+0''.099\pm0''.013$
B $\pi=+0''.084\pm0''.006$
C $\pi=+0''.112\pm0''.008$

From heliometer observations, Chase finds for the mean of A and B, $\pi=+0''.134\pm0''.050$.

The plates were measured in both co-ordinates for proper motion. The results by Slocum, together with those published by Furuhjelm, are:

Star	μ_s	Mean	Furuhjelm
A.....	0''.849 in 95°.6	0''.868 in 96°.6	0''.845 in 99°.8
B.....	0''.888 in 101°.6		
C.....	0''.844 in 98°.3		0''.855 in 100°.0

The agreement is very satisfactory, considering the fact that our plates were all taken within a single year.

For the relative positions of the components of the double star, I find

P = 138°.23 D = 4''.78 for 1912.48

These values indicate a change of 27° in P and 0''.29 in D since 1876.

30 ε Andromedae (0^h33^m, $+28°46'$)

This is a star of spectral type G 5, with large radial velocity, −84 km per second. The proper motion is also relatively large, 0''.34 per year. Fourteen plates were secured, and were measured by Mr. Slocum. The rotating disk was used to reduce the brightness of the parallax star.

TABLE 1

PLATES OF 30ε ANDROMEDAE

No.	Date	Hour Angle	Observers	Quality of Images
454.....	1911 July 29	−1h2	Su, V	Good
463.....	Aug. 5	−1.3	Su, Sl	Poor
469.....	Aug. 19	−0.8	Su, Sl	Good
539.....	Oct. 28	−0.8	Su, Sl	Good
571.....	Dec. 5	+0.2	Su, Sl	Fair
585.....	Dec. 15	−0.3	Sl, V	Good
618.....	1912 Jan. 1	−0.3	Sl, Sl	Fair
830.....	July 28	−1.1	Su, M	Poor
837.....	July 29	−1.0	Su, M	Fair
841.....	Aug. 3	−0.5	Su, Sl	Fair
1018.....	Nov. 28	+0.3	Su, Sl	Good
1031.....	Dec. 14	−0.3	M, Sl	Good
1046..	Dec. 22	0.0	Sl, Sl	Good
1337.... .	1913 Aug. 2	−0.7	Su, M	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.19	−352	− 11	+0.631
3.....	.18	+ 40	−124	− .246
4.....	.15	+312	+135	+0.615
Parallax star...	0.27	− 39.9	+106.6	.....

The mean magnitude of the comparison stars is approximately 9.4.

TABLE 2

REDUCTIONS FOR 30 ϵ ANDROMEDAE

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
454....	+0.085	1.0	+0.833	−277	−0.015	−0″.04
463....	+ .092	0.4	+ .777	−270	− .006	− .01
469....	+ .085	1.0	+ .635	−256	− .007	− .02
539....	+ .044	1.0	− .391	−186	− .016	− .04
571....	+ .064	0.7	− .811	−148	+ .019	+ .04
585....	+ .036	1.0	− .868	−138	− .006	− .02
618....	+ .066	0.7	− .904	−121	+ .029	+ .06
830....	+ .080	0.4	+ .834	+ 88	+ .063	+ .11
837....	+ .056	0.7	+ .827	+ 89	+ .040	+ .09
841....	.000	0.7	+ .788	+ 94	− .015	− .03
1018....	− .048	1.0	− .763	+211	− .012	− .03
1031....	− .038	1.0	− .867	+227	+ .003	+ .01
1046....	− .050	1.0	− .894	+235	− .006	− .02
1337....	−0.082	1.0	+0.798	+458	−0.014	−0.04

The normal equations are:

$$11.6\,c + 1.4100\,\mu - 0.9426\,\pi = +0.2310$$
$$+62.6513 \quad -1.9380 \quad = -1.4237$$
$$+7.2389 \quad = +0.1348$$

from which

$$c = +0.0239$$
$$\mu = -0.0228 = -0''.061 \qquad \mu_a = -0^s.017$$
$$\pi = +0.0156 = +0''.042 \pm 0''.014$$

Probable error corresponding to unit weight,

$$\pm 0.0138 = \pm 0''.037$$

37 μ Andromedae (0^h51^m, +37°57′)

This is a star of spectral type A 2 with a proper motion of 0″.15 per year. It is No. 497 in Burnham's *General Catalogue of Double Stars*. There are two faint companions, both apparently optical. On our plates both are cut out by the rotating disk, which was used to reduce the brightness of the parallax star. Sixteen plates were secured, and were measured by Mr. Slocum.

TABLE 1

PLATES OF 37 μ ANDROMEDAE

No.	Date	Hour Angle	Observers	Quality of Images
540.....	1911 Oct. 28	−0^{h}6	Su, Sl	Good
586.....	Dec. 15	−0.2	Sl, V	Good
609.....	Dec. 25	−0.3	V, Sl	Good
832.....	1912 July 28	−0.4	Su, M	Good
849.....	Aug. 4	+0.1	Su, M	Fair
854.....	Aug. 11	−0.8	Su, M	Good
1008.....	Nov. 17	−0.2	Su, Sl	Good
1037.....	Dec. 21	−0.3	Sl, Sl	Good
1060.....	1913 Jan. 11	+0.1	Sl, Sl	Poor
1067.....	Jan. 12	+0.1	Sl, Sl	Poor
1331.....	July 26	−0.6	Su, M	Fair
1338.....	Aug. 2	−0.6	Su, M	Fair
1339.....	Aug. 2	−0.2	Su, M	Good
1345.....	Aug. 21	−0.1	Su, Su	Fair
1349.....	Aug. 23	−0.1	Su, Su	Good
1353.....	Aug. 24	+0.1	Su, Su	Poor

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−297	− 1	+0.434
3.....	.27	− 91	−114	.119
4.....	.18	+140	+139	.391
5.....	.15	+248	− 24	+0.056
Parallax star...	0.32	− 71.2	+ 39.0	.....

The mean magnitude of the comparison stars is approximately 9.3.

TABLE 2

REDUCTIONS FOR 37 μ ANDROMEDAE

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
540....	−0.220	1.0	−0.321	−410	−0.005	−0″.01
586....	.217	1.0	− .846	−362	− .009	− .02
609....	.190	1.0	− .890	−352	+ .016	+ .04
832....	.168	1.0	+ .869	−136	− .002	.00
849....	.146	0.7	+ .822	−129	+ .019	+ .04
854....	.176	1.0	+ .764	−122	− .012	− .03
1008....	.152	1.0	− .602	− 24	− .002	.00
1037....	.146	1.0	− .879	+ 10	− .001	.00
1060....	.153	0.4	− .900	+ 31	− .011	− .02
1067....	.136	0.4	− .898	+ 32	+ .006	+ .01
1331....	.118	0.7	+ .881	+227	− .013	− .03
1338....	.108	0.7	+ .838	+234	− .004	− .01
1339....	.092	1.0	+ .838	+234	+ .012	+ .03
1345....	.106	0.7	+ .664	+253	− .005	− .01
1349....	.098	1.0	+ .642	+255	+ .003	+ .01
1353....	−0.096	0.4	+0.630	+256	+0.005	+0.01

The normal equations are:

$$13.0\,c - 3.6990\,\mu + 1.3513\,\pi = -1.9476$$
$$+73.4748 \quad +12.6769 \quad = +1.8013$$
$$+ 7.8210 \quad = +0.0330$$

from which

$$c = -0.1452$$
$$\mu = +0.0169 = +0''.045 \qquad \mu_a = 0^s.014$$
$$\pi = +0.0020 = +0''.005 \pm 0''.007$$

Probable error corresponding to unit weight,

$$\pm 0.0063 = \pm 0''.017$$

Lalande 1966 (1^h3^m, +61°1′)

This is a star of magnitude 7.1 and spectral type F 3. It has a proper motion of 0″.64 per year and an exceedingly large radial velocity, −325 km per second. Eleven plates were secured, and were measured by Mr. Mitchell. The rotating disk was used.

TABLE 1

PLATES OF LALANDE 1966

No.	Date	Hour Angle	Observers	Quality of Images
541.....	1911 Oct. 28	−0h2	Su, V	Fair
572.....	Dec. 5	+0.2	Si, Si	Fair
590.....	Dec. 18	0.0	Si, Su	Good
610.....	Dec. 25	−0.2	V, Si	Fair
842.....	1912 Aug. 3	−0.4	Su, Si	Good
843.....	Aug. 3	−0.1	Su, Si	Poor
855.....	Aug. 11	−0.3	Su, M	Good
859.....	Aug. 17	−0.4	Su, Si	Fair
1024.....	Dec. 8	−0.3	Su, Si	Good
1032.....	Dec. 14	−0.1	M, Su	Good
1051.....	Dec. 28	0.0	Si, Si	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−407	+332	+0.230
2.....	.19	− 82	− 83	.116
3.....	.20	+ 78	−125	.157
4.....	.16	+191	− 94	.223
5.....	.16	+220	− 30	+0.274
Parallax star...	0.16	+ 11.9	+ 18.0	.....

The mean magnitude of the comparison stars is approximately 9.4.

TABLE 2

REDUCTIONS FOR LALANDE 1966

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
541....	−0.232	0.7	−0.273	−231	−0.018	−0″.04
572....	− .170	0.7	− .750	−193	+ .016	+ .04
590....	− .176	1.0	− .847	−180	+ .001	.00
610....	− .172	0.7	− .881	−173	+ .001	.00
842....	− .031	1.0	+ .854	+ 49	.000	.00
843....	− .020	0.5	+ .854	+ 49	+ .011	+ .02
855....	− .039	1.0	+ .794	+ 57	− .014	− .04
859....	+ .008	0.5	+ .740	+ 63	+ .029	+ .05
1024....	+ .040	1.0	− .782	+176	− .021	− .06
1032....	+ .064	1.0	− .827	+182	− .001	.00
1051....	+0.091	1.0	−0.894	+196	+0.016	+0.04

The normal equations are:

$$9.1\,c + 1.1810\,\mu - 2.2378\,\pi = -0.4588$$
$$+22.8128 \quad +0.7259 \quad = +1.4553$$
$$+5.7995 \quad = +0.1601$$

from which

$$c = -0.0601$$
$$\mu = +0.0670 = +0″.178 \qquad \mu_a = +0″.089$$
$$\pi = -0.0040 = -0″.011 \pm 0″.012$$

Probable error corresponding to unit weight,

$$\pm 0.0101 = \pm 0″.027$$

Chase has found for this star $\pi = +0″.070 \pm 0″.037$.

B.D. 48°739 (2h36m, +48°34′)

This is a ninth-magnitude star, which was discovered, on the plates taken for θ Persei, to have a proper motion of 0″.38. This is very nearly the same, in amount, as the proper motion of θ Persei and its companion, but the direction is entirely different. Ten plates were measured by Mr. Slocum.

TABLE 1

PLATES OF B.D. 48°739

No.	Date	Hour Angle	Observers	Quality of Images
1069.....	1913 Jan. 12	−0h2	Si, Si	Fair
1082.....	Jan. 25	−0.6	Si, M	Fair
1083.....	Jan. 25	−0.1	M, Si	Good
1355.....	Sept. 6	−0.6	Su, Si	Fair
1356.....	Sept. 6	−0.2	Su, Si	Good
1366.....	Sept. 13	−0.6	Su, Si	Fair
1367.....	Sept. 13	−0.1	Su, Si	Fair
1379.....	Sept. 14	0.0	Su, Si	Fair
1477.....	1914 Jan. 17	−1.0	Si, Si	Good
1478.....	Jan. 17	−0.4	Si, Si	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−268	− 88	+0.398
2.....	.18	−181	+137	.044
3.....	.14	+ 54	− 23	.220
4.....	.11	+157	+ 27	.120
5.....	.14	+238	− 53	+0.218
Parallax star...	0.19	− 32.1	− 42.4	.....

The mean magnitude of the comparison stars is approximately 10.5.

TABLE 2

REDUCTIONS FOR B.D. 48°739

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
1069....	−0.160	0.7	−0.883	−197	+0.003	+0″.01
1082....	.161	0.7	− .931	−184	+ .003	+ .01
1083....	.168	1.0	− .931	−184	− .004	− .01
1355....	.104	0.7	+ .809	+ 40	+ .003	+ .01
1356....	.123	1.0	+ .809	+ 40	− .022	− .06
1366....	.091	0.7	+ .741	+ 47	+ .017	+ .04
1367....	.094	0.7	+ .741	+ 47	+ .014	+ .03
1379....	.108	0.7	+ .730	+ 48	.000	.00
1477....	.137	1.0	− .906	+173	+ .002	+ .01
1478....	−0.142	1.0	−0.906	+173	−0.003	−0.01

The normal equations are:

$$8.2\,c + 0.6270\,\mu - 1.0891\,\pi = -1.0786$$
$$+15.2005 \quad +2.2780 \quad = +0.0766$$
$$+5.9153 \quad = +0.2986$$

from which

$$c = -0.1288$$
$$\mu = +0.0067 = +0″.018 \qquad \mu_a = +0″.007$$
$$\pi = +0.0242 = +0″.064 \pm 0″.009$$

Probable error corresponding to unit weight,

$$\pm 0.0076 = \pm 0″.020$$

13 θ Persei (2^h37^m, $+48°48'$)

This is a double star of the type of 61 Cygni. The components are of magnitude 4.2 and 10, separated by 18″, and have nearly the same proper motion, 0″.34 per year. Two series of plates were taken, one for the brighter star, with the sector of the rotating disk set to reduce its light about five magnitudes; the second series, for the tenth-magnitude companion, with the disk removed. Both series were measured by Mr. Slocum.

TABLE 1

PLATES OF 13θ PERSEI

No.	Date	Hour Angle	Observers	Quality of Images
564.....	1911 Dec. 1	−0h3	V	Good
574.....	Dec. 5	−0.3	Su, Sl	Good
621.....	1912 Jan. 1	−0.5	Su, Sl	Fair
861.....	Aug. 17	−0.6	Su, Sl	Fair
864.....	Aug. 24	−1.2	Su, Sl	Fair
886.....	Sept. 7	−0.4	Su, M	Poor
1039.....	Dec. 21	0.0	Su, Si	Fair
1052.....	Dec. 28	−0.9	Si, Su	Fair
1068.....	1913 Jan. 12	−0.8	Si, Si	Fair
1082.....	Jan. 25	−0.6	Si, M	Good
1355.....	Sept. 6	−0.6	Su, Si	Good
1366.....	Sept. 13	−0.6	Su, Si	Fair
1378.....	Sept. 14	−0.5	Su, Si	Good
1477.....	1914 Jan. 17	−1.0	Si, Si	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.16	−190	+ 4	+0.137
2.....	.14	+ 8	−215	.271
3.....	.20	+182	+211	+0.592
Parallax star...	0.24	+ 83.9	+ 67.2	.....

The mean magnitude of the comparison stars is approximately 11.0.

TABLE 2

REDUCTIONS FOR 13θ PERSEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
564....	−0.290	0.7	−0.424	−370	−0.011	−0″.02
574....	.285	1.0	− .482	−366	− .005	− .01
621....	.269	0.7	− .796	−339	+ .011	+ .03
861....	.140	0.7	+ .938	−110	+ .008	+ .02
864....	.154	0.7	+ .905	−103	− .007	− .02
886....	.135	0.4	+ .801	− 89	+ .011	+ .02
1039....	.158	0.7	− .695	+ 16	− .002	.00
1052....	.157	0.7	− .766	+ 23	− .001	.00
1068....	.149	0.7	− .881	+ 38	+ .006	+ .01
1082....	.150	1.0	− .931	+ 51	+ .002	+ .01
1355....	.020	1.0	+ .812	+275	+ .002	.00
1366....	.025	0.7	+ .745	+282	− .004	− .01
1378....	.023	1.0	+ .734	+283	− .002	.00
1477....	−0.032	1.0	−0.906	+408	−0.002	−0.01

The normal equations are:

$$11.0\,c + 2.2130\,\mu - 1.1344\,\pi = -1.5034$$
$$+71.1302 \quad +4.2653 \quad = +2.2403$$
$$+6.8139 \quad = +0.5160$$

from which

$$c = -0.1403$$
$$\mu = +0.0340 = +0″.090 \qquad \mu_a = +0″.033$$
$$\pi = +0.0311 = +0″.083 \pm 0″.004$$

Probable error corresponding to unit weight,

$$\pm 0.0039 = \pm 0″.010$$

TABLE 1

PLATES OF 13θ PERSEI, COMPANION STAR

No.	Date	Hour Angle	Observers	Quality of Images
865.....	1912 Aug. 24	−0h7	Su, Si	Poor
887.....	Sept. 7	0.0	M, Su	Poor
1053.....	Dec. 28	−0.4	Su, Si	Fair
1069.....	1913 Jan. 12	−0.2	Si, Si	Fair
1083.....	Jan. 25	−0.1	M, Si	Good
1356.....	Sept. 6	−0.2	Su, Si	Good
1367.....	Sept. 13	−0.1	Su, Si	Good
1379.....	Sept. 14	0.0	Su, Si	Good
1478.....	1914 Jan. 17	−0.4	Si, Si	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.14	−190	+ 4	+0.162
2.....	.12	+ 8	−215	.251
3.....	.19	+182	+211	+0.587
Parallax star...	0.19	+ 78.1	+ 70.5	.....

The mean magnitude of the comparison stars is approximately 11.0.

TABLE 2

REDUCTIONS FOR 13θ PERSEI, COMPANION STAR

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
865....	−0.124	0.4	+0.905	−233	−0.006	+0″.01
887....	− .115	0.4	+ .801	−219	+ .002	.00
1053....	− .109	0.7	− .767	−107	+ .011	+ .03
1069....	− .124	0.7	− .881	− 92	− .006	− .01
1083....	− .118	1.0	− .931	− 79	− .003	− .01
1356....	+ .008	1.0	+ .812	+145	+ .001	.00
1367....	+ .012	1.0	+ .744	+152	+ .005	+ .01
1379....	+ .002	1.0	+ .734	+153	− .005	− .01
1478....	+0.005	1.0	−0.906	+278	−0.001	0.00

The normal equations are:

$$7.2\,c + 3.2890\,\mu - 0.0182\,\pi = -0.3497$$
$$+20.5902 \quad +1.2448 \quad = +0.5178$$
$$+4.9786 \quad = +0.1755$$

from which

$$c = -0.0639$$
$$\mu = +0.0337 = +0″.090 \qquad \mu_a = +0″.033$$
$$\pi = +0.0266 = +0″.071 \pm 0″.004$$

Probable error corresponding to unit weight,

$$\pm 0.0038 = \pm 0″.010$$

33 α Persei (3^h17^m, $+49°30'$)

33 α Persei is of magnitude 1.9 and spectral type F5. It has an exceedingly small proper motion and likewise a small radial velocity. Fourteen plates were used. They were measured by Mr. Slocum. The rotating disk was used.

TABLE 1

PLATES OF 33 α PERSEI

No.	Date	Hour Angle	Observers	Quality of Images
30	1907 Sept. 20	−1h0	J, Su	Fair
42	Oct. 12	−0.6	J, Su, J	Fair
58	1908 Jan. 4	+1.7	J, J	Fair
74	Aug. 22	−0.9	F, Su, F	Fair
121	Sept. 25	−0.7	Su, Sl	Fair
177	Dec. 30	−0.1	Su, Sl, Su	Fair
489	1911 Sept. 2	−1.2	Su, Sl	Fair
504	Sept. 16	−1.2	Su, Sl	Good
653	1912 Feb. 7	−0.2	Sl, Sl	Fair
906	Sept. 15	−0.3	Su, M	Good
1084	1913 Jan. 25	−0.2	M, Sl	Good
1088	Feb. 1	−0.6	M, Sl	Fair
1089	Feb. 1	−0.2	M, Sl	Fair
1112	Feb. 8	0.0	M, M	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.22	−260	−205	+0.241
2	.13	−232	+200	.223
3	.21	+207	−144	.272
4	.18	+285	+149	+0.264
Parallax star	0.41	+ 17.3	− 4.5	.....

The mean magnitude of the comparison stars is approximately 9.0.

TABLE 2

REDUCTIONS FOR 33 α PERSEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
30	+0.212	0.7	+0.791	−1443	−0.002	0″.00
42	.233	0.9	+ .533	−1421	+ .018	+ .05
58	.228	0.7	− .744	−1337	+ .009	+ .02
74	.207	0.9	+ .967	−1106	− .009	− .02
121	.198	0.7	+ .734	− 707	− .022	− .05
177	.221	0.9	− .694	− 611	− .004	− .01
489	.207	0.7	+ .927	0	− .018	− .04
504	.216	1.0	+ .828	+ 14	− .009	− .02
653	.233	0.7	− .950	+ 158	+ .001	.00
906	.260	1.0	+ .830	+ 379	+ .032	+ .09
1084	.222	1.0	− .912	+ 511	− .012	− .03
1088	.224	0.7	− .940	+ 518	− .010	− .02
1089	.260	0.7	− .940	+ 518	+ .026	+ .06
1112	+0.228	0.7	−0.952	+ 525	−0.007	−0.01

The normal equations are:

$$11.3c - 31.5780\mu + 0.0196\pi = +2.5459$$
$$+730.4009 \quad -30.0500 \quad = -6.5101$$
$$+ 8.0443 \quad = -0.0446$$

from which

$$c = +0.2275$$
$$\mu = +0.0008 = +0''.002 \qquad \mu_\alpha = +0''.001$$
$$\pi = -0.0031 = -0''.008 \pm 0''.011$$

Probable error corresponding to unit weight,

$$\pm 0.0108 = \pm 0''.029$$

Other values of the parallax of 33 α Persei have been obtained as follows:

+0″.074 ± 0″.028, by Pritchard
+0.100 ± 0.029, by Pritchard
+0.109 ± 0.025, by Flint

Lalande 6888–6889 (3^h40^m, $+41°9'$)

This is No. 1854 in Burnham's *General Catalogue*. There are two stars of magnitudes 8.2 and 8.8 with very nearly the same proper motion, 1″.4 per year. There is an eleventh-magnitude companion which has no appreciable proper motion. All three stars were measured by Mr. Mitchell.

TABLE 1

PLATES OF LALANDE 6888–6889

No.	Date	Hour Angle	Observers	Quality of Images
184	1910 Jan. 6	−0h2	Su, Sl	Good
303	Sept. 9	−1.0	Su, Su	Fair
363	1911 Jan. 21	−0.2	Su, Sl	Poor
490	Sept. 2	−1.1	V, Su	Fair–Good
505	Sept. 16	−1.1	Su, V	Good
654	1912 Feb. 7	−0.1	V, Sl	Fair–Good
657	Feb. 9	0.0	Sl, V	Good
889	Sept. 7	−0.1	Su, M	Poor
907	Sept. 15	−0.1	Su, M	Poor
911	Sept. 21	−0.9	Su, Sl	Fair
918	Sept. 22	−0.6	Su, M	Fair
1070	1913 Jan. 12	−0.4	Su, Sl	Good
1073	Jan. 23	−0.1	M, Su	Fair
1100	Feb. 2	0.0	M	Fair
1123	Feb. 9	0.0	M, Sl	Good
1131	Feb. 12	0.0	Sl, M	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
2	0.24	−350	+ 51	+0.274
3	.19	−140	+101	.210
4	.18	+ 95	−128	.314
5	.22	+395	− 24	+0.202
Lalande 6888	.39	− 16.9	− 10.8	.....
Lalande 6889	0.35	− 14.5	− 8.7	.....

COMPARISON STARS FOR ELEVENTH-MAGNITUDE STAR NEAR LALANDE 6888–6889

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
2	0.24	−350	+ 51	+0.279
3	.19	−140	+101	.179
4	.18	+ 95	−128	.359
5	.22	+395	− 24	+0.183
Parallax star	0.09	− 16.2	− 18.0	.....

The mean magnitude of the comparison stars is approximately 9.7.

TABLE 2

REDUCTIONS FOR LALANDE 6888

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
184....	−1.894	1.0	−0.716	−807	+0.015	+0″.04
303....	1.792	0.7	+ .925	−561	− .020	− .05
363....	1.718	0.4	− .857	−427	− .037	− .06
490....	1.563	0.7	+ .960	−203	− .004	− .01
505....	1.556	1.0	+ .881	−189	− .006	− .02
654....	1.421	0.7	− .947	− 45	+ .032	+ .07
657....	1.450	1.0	− .953	− 43	+ .002	+ .01
889....	1.309	0.4	+ .934	+168	+ .028	+ .05
907....	1.332	0.4	+ .882	+176	.000	.00
911....	1.312	0.7	+ .834	+182	+ .016	+ .03
918....	1.323	0.7	+ .824	+183	+ .004	+ .01
1070....	1.266	1.0	− .783	+295	− .015	− .04
1073....	1.270	0.7	− .876	+306	− .026	− .06
1100....	1.269	0.5	− .932	+316	− .032	− .06
1123....	1.232	1.0	− .954	+323	+ .001	.00
1131....	−1.208	1.0	−0.960	+326	+0.023	+0.06

The normal equations are:

$$11.9\,c - 0.6680\,\mu - 2.3634\,\pi = -17.0608$$
$$+149.5731 \quad -7.2149 \quad = +\ 9.9280$$
$$+9.4012 \quad = +\ 2.8958$$

from which

$$c = -1.4315$$
$$\mu = +0.0597 = +0''.159 \qquad \mu_a = +0^s.051$$
$$\pi = -0.0060 = -0''.016 \pm 0''.011$$

Probable error corresponding to unit weight,

$$\pm 0.0119 = \pm 0''.032$$

TABLE 3

REDUCTIONS FOR LALANDE 6889

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
184....	+0.453	1.0	−0.716	−807	+0.016	+0″.04
303....	0.575	0.7	+ .925	−561	− .020	− .05
363....	0.640	0.4	− .857	−427	− .031	− .05
490....	0.808	0.7	+ .960	−203	− .008	− .02
505....	0.822	1.0	+ .881	−189	− .003	− .01
654....	0.925	0.7	− .947	− 45	+ .018	+ .04
657....	0.910	1.0	− .953	− 43	+ .002	+ .01
889....	1.068	0.4	+ .934	+168	+ .023	+ .04
907....	1.058	0.4	+ .882	+176	+ .008	+ .01
911....	1.046	0.7	+ .834	+182	− .008	− .02
918....	1.076	0.7	+ .824	+183	+ .022	+ .05
1070....	1.122	1.0	− .783	+295	+ .005	+ .01
1073....	1.100	0.7	− .876	+306	− .024	− .05
1100....	1.115	0.5	− .932	+316	− .015	− .03
1123....	1.133	1.0	− .954	+323	− .001	.00
1131....	+1.138	1.0	−0.960	+326	+0.002	+0.01

The normal equations are:

$$11.9\,c - 0.6680\,\mu - 2.3634\,\pi = +11.1129$$
$$+149.5731 \quad -7.2149 \quad = +\ 8.5795$$
$$+9.4012 \quad = -\ 2.6271$$

from which

$$c = +0.9381$$
$$\mu = +0.0617 = +0''.164 \qquad \mu_a = +0^s.052$$
$$\pi = +0.0038 = +0''.010 \pm 0''.008$$

Probable error corresponding to unit weight,

$$\pm 0.0091 = \pm 0''.024$$

TABLE 4

REDUCTIONS FOR LALANDE 6888–6889, COMPANION STAR

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
184....	+0.086	1.0	−0.716	−807	+0.001	0ʰ00
490....	.070	0.7	+ .960	−203	+ .001	.00
505....	.066	1.0	+ .881	−189	− .004	− .01
520....	.076	0.5	+ .671	−168	+ .006	+ .01
654....	.082	0.7	− .947	− 45	+ .006	+ .01
657....	.068	1.0	− .953	− 43	− .008	− .02
918....	.066	0.5	+ .824	+183	+ .001	.00
1070....	.065	1.0	− .783	+295	− .006	− .02
1073....	.091	0.7	− .876	+306	+ .020	+ .05
1123....	.067	1.0	− .954	+323	− .004	− .01
1131....	+0.071	1.0	−0.960	+326	0.000	0.00

The normal equations are:

$$9.1\,c - 0.4690\,\mu - 3.3416\,\pi = +0.6641$$
$$+111.3114 \quad -6.7500 \quad = -0.1422$$
$$+7.0165 \quad = \quad 0.2616$$

from which

$$c = +0.0712$$
$$\mu = -0.0013 = -0''.003 \qquad \mu_a = -0^s.001$$
$$\pi = -0.0046 = -0''.012 \pm 0''.006$$

Probable error corresponding to unit weight,

$$\pm 0.0050 = \pm 0''.013$$

The following results have been obtained by others:

Star	Parallax	Observer	Method
6888.....	−0″.14 ±0″.04 ..	Flint	Meridian circle
	+ .035±0.045..	Chase	Heliometer
	+ .068±0.02 ..	von Zeipel	Photography
	+ .228±0.091..	Jewdokimov	Meridian circle
	− .029±0.033..	Russell	Photography
6889.....	+ .046±0.02 ..	von Zeipel	Photography
	+ .020±0.034..	Russell	Photography
6888–89....	+0.10 ±0.020..	Rambaut	Photography

46 ξ Persei (3^h52^m, +35°30′)

This is a spectroscopic binary. Its spectral type is Oe 5. From the H and K lines, J. B. Cannon has found a period of a trifle less than seven days. The other lines of the spectrum are too diffuse to give reliable results. The rotating disk was used to

reduce its brightness. Ten plates were secured, and were measured by Mr. Slocum.

TABLE 1

PLATES OF 46 ξ PERSEI

No.	Date	Hour Angle	Observers	Quality of Images
43.....	1907 Oct. 12	−0h5	J, Su, J	Fair
198.....	1910 Jan. 9	−0.9	Su, Sl	Good
632.....	1912 Jan. 8	−0.1	Su, V	Good
928.....	Sept. 29	−0.2	Su, M	Fair
1085.....	1913 Jan. 25	−0.4	M, Su	Fair
1090.....	Feb. 1	−0.2	M, Sl	Good
1091.....	Feb. 1	+0.2	M, Su	Fair
1113.....	Feb. 8	0.0	M, Sl	Good
1369.....	Sept. 13	−0.4	Su, Sl	Fair
1388.....	Sept. 27	−0.1	Su, Sl	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.30	−413	+194	+0.226
2.....	.14	− 49	−127	.248
3.....	.12	− 7	−274	.284
4.....	.22	+217	+255	.079
5.....	.21	+252	− 48	+0.163
Parallax star...	0.27	− 49.6	− 53.1	.....

The mean magnitude of the comparison stars is approximately 9.0.

TABLE 2

REDUCTIONS FOR 46 ξ PERSEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
43....	−0.221	0.9	+0.648	−1628	+0.012	+0.03
198....	.240	1.0	− .720	− 808	− .018	− .05
632....	.218	1.0	− .703	− 79	− .002	− .01
928....	.224	0.7	+ .789	+ 186	− .005	− .01
1085....	.226	0.7	− .873	+ 304	− .014	− .03
1090....	.194	1.0	− .917	+ 311	+ .018	+ .05
1091....	.193	0.7	− .917	+ 311	+ .019	+ .04
1113....	.215	1.0	− .948	+ 318	− .004	− .01
1369....	.216	0.7	+ .921	+ 535	.000	.00
1388....	−0.222	0.7	+0.811	+ 549	−0.006	−0.01

The normal equations are:

$$8.4\,c - 4.0370\,\mu - 2.1931\,\pi = -1.8226$$
$$+381.0247 \quad -5.2490 \quad = +1.2077$$
$$+5.7422 \quad = +0.4519$$

from which

$$c = -0.2175$$
$$\mu = +0.0008 = +0''.002 \qquad \mu_a = +0''.001$$
$$\pi = -0.0037 = -0''.010 \pm 0''.011$$

Probable error corresponding to unit weight,

$$\pm 0.0090 = \pm 0''.024$$

Argelander-Oeltzen 4961 (4^h30^m, $+52°42'$)

This is a star of magnitude 8.5. Its proper motion is given by Ristenpart in *Astronomische Nachrichten*, Vol. CLXXVII (1908), p. 337, as $+0''.029$, $-0''.40$. Thirteen plates were secured, and were measured by Mr. Slocum.

TABLE 1

PLATES OF A. OE. 4961

No.	Date	Hour Angle	Observers	Quality of Images
625.....	1912 Jan. 1	−0h2	Su, Sl	Good
642.....	Jan. 20	−0.2	Su, V	Good
655.....	Feb. 7	−0.5	V, Sl	Good
658.....	Feb. 9	−0.3	Sl, V	Good
890.....	Sept. 7	−0.5	M, Su	Good
908.....	Sept. 15	−0.3	Su, M	Good
912.....	Sept. 21	−0.5	Su, Sl	Good
919.....	Sept. 22	−0.5	Su, M	Fair
921.....	Sept. 28	−0.5	Su, Sl	Good
1074.....	1913 Jan. 23	−0.3	Su, M	Good
1086.....	Jan. 25	−0.4	Su, M	Good
1101.....	Feb. 2	−0.1	Su	Good
1114.....	Feb. 8	−0.1	M, Sl	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.27	−298	− 9	+0.370
2.....	.16	+132	+180	.400
3.....	.23	+166	−171	+0.230
Parallax star...	0.22	− 19.3	+ 29.2	.....

The mean magnitude of the comparison stars is approximately 8.5.

TABLE 2

REDUCTIONS FOR A. OE. 4961

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
625....	−0.181	1.0	−0.501	−264	−0.006	−0''.02
642....	.190	1.0	− .749	−245	− .012	− .03
655....	.168	1.0	− .908	−227	+ .010	+ .03
658....	.170	1.0	− .920	−225	+ .008	+ .02
890....	.051	1.0	+ .990	− 14	− .005	− .01
908....	.044	1.0	+ .965	− 6	.000	.00
912....	.032	1.0	+ .934	0	+ .012	+ .03
919....	.067	0.7	+ .928	+ 1	− .023	− .05
921....	.031	1.0	+ .886	+ 7	+ .012	+ .03
1074....	.075	1.0	− .789	+124	− .008	− .02
1086....	.061	1.0	− .809	+126	+ .006	+ .01
1101....	.082	0.7	− .878	+134	− .016	− .03
1114....	−0.052	0.7	−0.919	+140	+0.014	+0.03

The normal equations are:

$$12.1\,c - 5.3150\,\mu - 1.5093\,\pi = -1.1437$$
$$+28.9698 \quad +3.4390 \quad = +1.4166$$
$$+9.0622 \quad = +0.5405$$

from which

$$c = -0.0767$$
$$\mu = +0.0307 = +0''.082 \qquad \mu_a = +0''.033$$
$$\pi = +0.0352 = +0''.094 \pm 0''.007$$

Probable error corresponding to unit weight,

$$\pm 0.0081 = \pm 0''.022$$

37 ϕ^1 Orionis (5^h29^m, $+9°25'$)

This is a spectroscopic binary with the peculiarity that the H and K lines of calcium give quite different velocities from the other lines in its spectrum. It is of the B type and has a proper motion of only 0".01. Sixteen plates were secured, and were measured by Mr. Slocum. The rotating disk was used.

TABLE 1

PLATES OF 37 ϕ^1 ORIONIS

No.	Date	Hour Angle	Observers	Quality of Images
202	1910 Feb. 6	−0h1	Su, Sl	Fair
210	Feb. 12	+0.2	Su, Sl	Fair
217	Feb. 27	+0.5	Su, Sl	Fair
332	Oct. 22	−1.7	Su, Sl	Good
380	1911 Mar. 4	+0.8	Su, Sl	Fair
508	Sept. 16	−1.2	Sl	Poor
544	Oct. 28	+0.6	V, Sl	Poor
660	1912 Feb. 9	−0.4	Su, V	Good
680	Mar. 3	+0.2	Sl, V	Good
935	Oct. 5	−1.4	Su, Sl	Fair
945	Oct. 13	−1.1	Su, M	Good
953	Oct. 19	−0.9	Su, Sl	Good
1075	1913 Jan. 23	−0.4	Su, M	Good
1092	Feb. 1	−0.8	Su, M	Fair
1103	Feb. 6	−0.3	Su. Sl	Good
1145	Mar. 6	0.0	M, Sl	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.22	−304	+222	+0.188
2	.19	−260	− 21	.233
3	.19	+169	−235	.303
4	.25	+395	+ 34	+0.276
Parallax star	0.31	+ 42.2	− 24.9	.....

The mean magnitude of the comparison stars is approximately 9.7.

TABLE 2

REDUCTIONS FOR 37 ϕ^1 ORIONIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
202	−0.284	0.7	−0.800	−733	+0.016	+0".04
210	.295	0.7	−0.858	−727	+ .005	+ .01
217	.309	0.7	−0.958	−712	− .009	− .02
332	.303	1.0	+0.805	−475	− .002	− .01
380	.300	0.7	−0.976	−342	− .004	− .01
508	.291	0.3	+1.004	−146	+ .007	+ .01
544	.321	0.4	+0.740	−104	− .024	− .04
660	.305	1.0	−0.825	0	− .012	− .03
680	.292	1.0	−0.975	+ 23	+ .001	.00
935	.275	0.7	+0.940	+239	+ .019	+ .04
945	.308	1.0	+0.883	+247	− .014	− .04
953	.286	1.0	+0.829	+253	+ .008	+ .02
1075	.288	1.0	−0.638	+349	+ .002	+ .01
1092	.292	0.7	−0.749	+358	− .002	.00
1103	.286	1.0	−0.803	+363	+ .004	+ .01
1145	−0.287	0.7	−0.983	+391	+0.002	0.00

The normal equations are:

$$12.6\,c - 3.9360\,\mu - 3.1956\,\pi = -3.7131$$
$$+203.4988 + 6.9288 = +1.3448$$
$$+9.2797 = +0.9321$$

from which

$$c = -0.2948$$
$$\mu = +0.0010 = +0''.003 \qquad \mu_a = +0^s.001$$
$$\pi = -0.0018 = -0''.005 \pm 0''.006$$

Probable error corresponding to unit weight,

$$\pm 0.0065 = \pm 0''.017$$

40 ϕ^2 Orionis (5^h31^m, $+9°15'$)

This star is only half a degree from ϕ^1 Orionis and is of practically the same magnitude, but in other respects the stars are entirely different. ϕ^2 Orionis is of the K type, with a radial velocity of +97 km per second, and a proper motion of 0".32 per year. Fourteen plates were secured, and were measured by Mr. Mitchell. The rotating disk was used.

TABLE 1

PLATES OF 40 ϕ^2 ORIONIS

No.	Date	Hour Angle	Observers	Quality of Images
203	1910 Feb. 6	+0h3	Su, Sl	Good
218	Feb. 27	+0.8	Su, Sl	Good
333	Oct. 22	−1.2	Su, Sl	Poor
381	1911 Mar. 4	+1.1	Su, Sl	Fair
509	Sept. 16	−0.9	Su, Sl	Fair
523	Oct. 7	−1.1	Su, Sl	Fair
545	Oct. 28	+1.0	Su, Sl	Poor
645	1912 Jan. 20	0.0	Su, Sl	Good
681	Mar. 3	+0.5	Su, Sl	Good
946	Oct. 13	−0.2	Su, M	Fair
954	Oct. 19	−0.1	Su, Sl	Good
1087	1913 Jan. 25	−0.7	Su, M	Good
1104	Feb. 6	+0.4	Su, Sl	Good
1154	Mar. 8	+0.2	M, Sl	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.14	−381	−265	+0.182
3	.20	−140	+ 81	.220
4	.13	− 78	+242	.250
5	.16	− 2	−216	.109
6	.16	+291	+145	.139
7	.28	+310	+ 13	+0.100
Parallax star	0.30	− 48.5	+ 28.1	.....

The mean magnitude of the comparison stars is approximately 9.5.

TABLE 2

REDUCTIONS FOR 40 ϕ^2 ORIONIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
203....	−0.200	1.0	−0.796	−660	−0.019	−0″.05
218....	.178	1.0	−0.956	−639	+ .002	.00
333....	.096	0.4	+0.809	−402	+ .054	+ .09
381....	.136	0.7	−0.975	−269	+ .009	+ .02
509....	.122	0.7	+1.004	− 73	− .004	− .01
523....	.101	0.7	+0.935	− 52	+ .016	+ .03
545....	.121	0.4	+0.745	− 31	− .006	− .01
645....	.124	1.0	−0.580	+ 53	− .011	− .03
681....	.108	1.0	−0.974	+ 96	+ .002	+ .01
946....	.116	0.7	+0.886	+320	− .035	− .08
954....	.082	1.0	+0.833	+326	− .001	.00
1087....	.070	1.0	−0.658	+424	+ .008	+ .02
1104....	.069	1.0	−0.799	+436	+ .008	+ .02
1154....	−0.072	0.7	−0.987	+466	+0.003	+0.01

The normal equations are:

$$11.3\,c + 1.3720\,\mu - 2.7043\,\pi = -1.3007$$
$$+167.7085 \quad +4.9164 \quad = +1.4529$$
$$+8.2961 \quad = +0.3910$$

from which

$$c = -0.1153$$
$$\mu = +0.0095 = +0''.025 \qquad \mu_a = +0^s.006$$
$$\pi = +0.0039 = +0''.010 \pm 0''.011$$

Probable error corresponding to unit weight,

$$\pm 0.0109 = \pm 0''.029$$

Trapezium in Orion Nebula (5^h30^m, $-5°27'$)

An attempt has here been made to get some idea of the distance of the Orion Nebula on the assumption that the trapezium stars are immersed in the nebulosity. The four brighter stars were measured. The fifth and sixth appear on some of the plates, but are too faint for accurate measurement, and, moreover, their spectra are unknown and their connection with the nebula is uncertain. All four stars were placed behind the rotating disk and cut down about 2.5 magnitudes. This made the average size of the trapezium stars exactly equal to the average size of the comparison stars, but the images of the individual stars in the trapezium range from 0.12 mm to 0.35 mm corresponding to 7.9 and 5.4 magnitudes, respectively. As a result of the use of the color filter and a comparatively short exposure there is no trace of nebulosity on the plates. Eight plates were measured by Mr. Slocum.

TABLE 1

PLATES OF TRAPEZIUM IN ORION NEBULA

No.	Date	Hour Angle	Observers	Quality of Images	Remarks
958..	1912 Oct. 20	+0^{h}6	Su, M	.....	A fair, B one good, C good, D good
977..	Nov. 2	0.0	Su, Sl	.....	A good, B fair, C fair, D good
1163..	1913 Mar. 9	+0.4	M, Sl	Good	
1389..	Sept. 27	−0.3	Su, Sl	Fair	
1403..	Oct. 12	−1.1	Su, Sl	Good	
1497..	1914 Feb. 15	−0.2	Su, Sl	Good	
1510..	Mar. 1	0.0	Sl, Sl	.....	A fair, B one poor, C fair, D fair
1529..	Mar. 14	+0.6	Sl, Sl	.....	A good, B fair, C fair, D good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.14	−371	0	+0.172
2.....	.16	−139	−228	.173
3.....	.38	− 64	+242	.163
4.....	.22	+ 81	−226	.170
5.....	.19	+101	+242	.160
6.....	.27	+392	− 30	+0.162
Parallax star A	.19	.....	.....	.....
Parallax star B	.12	− 4.9	− 4.4	.....
Parallax star C	.35	.....	.....	.....
Parallax star D	0.20	.....	.....	.....

TABLE 2

REDUCTIONS FOR TRAPEZIUM IN ORION NEBULA, A

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
958....	−3.444	0.7	+0.821	−293	−0.021	−0″.05
977....	3.416	1.0	+ .673	−280	+ .007	+ .02
1163....	3.408	1.0	− .989	−153	+ .008	+ .02
1389....	3.425	0.7	+ .981	+ 49	+ .004	+ .01
1403....	3.424	1.0	+ .895	+ 64	+ .005	+ .01
1497....	3.420	1.0	− .881	+190	+ .002	.00
1510....	3.419	0.7	− .966	+204	+ .002	+ .01
1529....	−3.432	1.0	−0.993	+217	−0.011	−0.03

The normal equations are:

$$7.1\,c + 0.1000\,\mu - 0.7098\,\pi = -24.3016$$
$$+28.0000 \quad -6.3540 \quad = -\ 0.3512$$
$$+5.7930 \quad = +\ 2.4088$$

from which

$$c = -3.4233$$
$$\mu = -0.0015 = -0''.004 \qquad \mu_a = -0^s.001$$
$$\pi = -0.0053 = -0''.014 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0.0072 = \pm 0''.019$$

TABLE 3

REDUCTIONS FOR TRAPEZIUM IN ORION NEBULA, B

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
958....	−1.710	0.7	+0.821	−293	−0.022	−0″.05
977....	1.676	0.7	+ .673	−280	+ .011	+ .03
1163....	1.668	1.0	− .989	−153	+ .007	+ .02
1389....	1.686	0.7	+ .981	+ 49	+ .014	+ .03
1403....	1.702	1.0	+ .895	+ 64	− .003	− .01
1497....	1.684	1.0	− .881	+190	+ .002	+ .01
1510....	1.699	0.3	− .966	+204	− .014	− .02
1529....	−1.692	0.7	−0.993	+217	−0.006	−0.01

The normal equations are:

$$\begin{aligned} 6.1\,c - 0.5270\,\mu - 0.2274\,\pi &= -10.2985 \\ +22.5707 \quad -4.3540 \quad &= +\ 0.8671 \\ +4.9880 \quad &= +\ 0.3484 \end{aligned}$$

from which

$$c = -1.6889$$
$$\mu = -0.0029 = -0''.008 \qquad \mu_a = -0^s.002$$
$$\pi = -0.0097 = \mathbf{-0''.026 \pm 0''.010}$$

Probable error corresponding to unit weight,

$$\pm 0.0079 = \pm 0''.021$$

TABLE 4

REDUCTIONS FOR TRAPEZIUM IN ORION NEBULA, C

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
958....	+0.212	1.0	+0.821	−293	0.000	0″.00
977....	.210	0.7	+ .673	−280	− .002	.00
1163....	.222	1.0	− .989	−153	.000	.00
1389....	.195	0.7	+ .981	+ 49	+ .006	− .01
1403....	.206	1.0	+ .895	+ 64	+ .004	+ .01
1497....	.230	1.0	− .881	+190	+ .018	+ .05
1510....	.206	0.7	− .966	+204	− .006	− .01
1529....	+0.194	0.7	−0.993	+217	−0.018	+0.04

The normal equations are:

$$\begin{aligned} 6.8\,c - 0.5900\,\mu - 0.3675\,\pi &= +1.4335 \\ +26.8108 \quad -5.8639 \quad &= -0.1478 \\ +5.5635 \quad &= -0.1051 \end{aligned}$$

from which

$$c = +0.2102$$
$$\mu = -0.0026 = -0''.007 \qquad \mu_a = -0^s.002$$
$$\pi = -0.0077 = \mathbf{-0''.021 \pm 0''.010}$$

Probable error corresponding to unit weight,

$$\pm 0.0076 = \pm 0''.020$$

TABLE 5

REDUCTIONS FOR TRAPEZIUM IN ORION NEBULA, D

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
958....	+4.604	1.0	+0.821	−293	−0.003	−0″.01
977....	4.618	1.0	+ .673	−280	+ .010	+ .03
1163....	4.614	1.0	− .989	−153	− .007	− .02
1389....	4.602	0.7	+ .981	+ 49	.000	.00
1403....	4.597	1.0	+ .895	+ 64	− .006	− .02
1497....	4.614	1.0	− .881	+190	− .004	− .01
1510....	4.618	0.7	− .966	+204	.000	.00
1529....	+4.628	1.0	−0.993	+217	+0.010	+0.03

The normal equations are:

$$\begin{aligned} 7.4\,c - 0.7990\,\mu - 0.4635\,\pi &= +34.1290 \\ +30.5755 \quad -7.0756 \quad &= -\ 3.5551 \\ +5.9952 \quad &= -\ 2.1842 \end{aligned}$$

from which

$$c = +4.6114$$
$$\mu = -0.0008 = -0''.002 \qquad \mu_a = -0^s.000$$
$$\pi = -0.0088 = \mathbf{-0''.023 \pm 0''.007}$$

Probable error corresponding to unit weight,

$$\pm 0.0053 = \pm 0''.014$$

SUMMARY

A	$\pi = -0''.014 \pm 0''.009$
B	$\pi = -0.026 \pm 0.010$
C	$\pi = -0.021 \pm 0.010$
D	$\pi = -0.023 \pm 0.007$

The question, of course, arises as to whether the comparison stars may not also be connected with the nebula. The mean of their distances from the trapezium is 13′, which is not sufficiently great to place them beyond the region covered by nebulosity, but is about as far as stars can conveniently be selected on the 8×10-inch plates used with the 40-inch refractor.

Since the plates were measured and reduced, Professor Pickering has kindly sent the following data for the comparison stars:

No.	Bond Number	Spectrum	Photographic Magnitude	Photo-visual Magnitude	Color-Index
3.....	554	B8	7.64	7.65	−0.01
6.....	924	A0	8.85	9.00	−0.15
5.....	757	A	9.63	9.56	+0.07
4.....	746	.....	9.83	9.45	+0.38
1.....	303	.....	10.52	9.98	+0.54
2.....	497	.....	10.80	9.87	+0.93

From the spectra of the brighter stars, Nos. 3, 6, and 5, we cannot be sure that they do not belong to the nebula. From the color-indices of the fainter stars, however, we must infer either that they are of

a more advanced type or that their light is subject to some abnormal absorption.

It will be desirable to make another determination of the parallaxes of the trapezium stars, using plates which cover a larger field so that more distant stars may be used for comparison. The spectra of the stars should be investigated beforehand, and only those stars selected which are apparently independent of the nebula.

As to the negative results obtained, from the agreement of the four values it would seem natural to infer either that the nebula is really farther away than the comparison stars or that some systematic error has crept in.

If we assume that the nebula is at the same distance as the reference stars and adopt Kapteyn's value of +0".005 as the parallax of stars of their mean magnitude, we get for the distance of the nebula 652 light-years.

On photographs taken with the more powerful instruments, the brighter portion of the nebula covers an area about one degree in diameter. If the nebula is at the distance given above, this would correspond to a real diameter of 11 light-years.

Weisse II 8^{h}596 (8^{h}29^m, +42°6′)

This is a star of magnitude 8.6, with a proper motion of 0".76 per year. Ten plates were measured by Mr. Mitchell.

TABLE 1

PLATES OF WEISSE II 8^{h}596

No.	Date	Hour Angle	Observers	Quality of Images
576	1911 Dec. 5	−0^{h}9	Su, Sl	Fair–Good
597	Dec. 18	−1.1	Sl, V	Good
685	1912 Mar. 5	−0.2	Sl, Su	Fair–Good
708	Mar. 21	−0.4	V, Sl	Poor
964	Oct. 26	−0.7	Su, Sl	Poor
1001	Nov. 16	−0.7	Su, Sl	Poor
1010	Nov. 17	−0.5	Su, M	Fair–Good
1166	1913 Mar. 9	−0.9	Su, Sl	Fair
1171	Mar. 16	−0.9	Su, Sl	Fair–Good
1176	Mar. 29	−0.1	Su, M	Poor

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.17	−449	−256	+0.189
2	.22	−413	+254	.164
3	.14	+ 49	+226	.155
4	.16	+144	−121	.169
5	.18	+307	−232	.171
6	.14	+362	+129	+0.152
Parallax star	0.13	− 12.7	− 12.2	.....

The mean magnitude of the comparison stars is approximately 11.5.

TABLE 2

REDUCTIONS FOR WEISSE II 8^{h}596

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p.v}$ in Arc
576	+0.469	0.8	+0.752	−264	+0.002	+0".01
597	.464	1.0	+ .597	−251	+ .001	.00
685	.421	0.8	− .622	−173	− .015	− .03
708	.453	0.4	− .803	−157	+ .022	+ .04
964	.380	0.4	+ .964	+ 62	− .011	− .02
1001	.368	0.4	+ .903	+ 83	− .018	− .03
1010	.398	0.8	+ .897	+ 84	+ .013	+ .03
1166	.346	0.7	− .668	+196	− .002	.00
1171	.348	0.8	− .749	+203	+ .002	.00
1176	+0.344	0.4	−0.869	+216	+0.002	0.00

The normal equations are:

$$6.5\,c - 1.5220\,\mu + 0.4298\,\pi = +2.6330$$
$$+24.1019 \quad -3.4636 \quad = -1.2014$$
$$+3.7810 \quad = +0.2793$$

from which

$$c = +0.3991$$
$$\mu = -0.0237 = -0".063 \qquad \mu_a = -0".021$$
$$\pi = +0.0068 = +0".018 \pm 0".010$$

Probable error corresponding to unit weight,

$$\pm 0.0067 = 0".018$$

Anonymous (11^{h}6^m, +6°59′)

This is a star of magnitude 9.5, discovered by Professor Max Wolf to have a proper motion of 0".97 per year. See *Astronomische Nachrichten*, Vol. CLXXI (1906), p. 327. The plates were measured by Mr. Slocum.

TABLE 1

PLATES OF ANONYMOUS (WOLF) 11^{h}6^m

No.	Date	Hour Angle	Observers	Quality of Images
392	1911 Apr. 1	+0^{h}2	Su, Sl	Good
603	Dec. 18	−0.5	Su, Sl	Good
743	1912 Apr. 14	+0.4	Su, V	Fair
1055	Dec. 28	−1.0	Su, Sl	Good
1077	1913 Jan. 23	−1.0	Su, Sl	Poor
1206	Apr. 26	−0.2	M, Su	Fair
1209	May 10	+1.1	Su, M	Fair
1215	May 11	+0.2	Su, Sl	Fair
1472	Dec. 21	−0.6	Su, Sl	Fair
1481A	1914 Jan. 24	+0.3	Su, Sl	Poor

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.14	−337	− 47	+0.155
2	.34	−277	−169	.158
3	.22	− 98	+139	.162
4	.14	+172	−236	.176
5	.18	+271	+ 12	.176
6	.24	+269	+301	+0.173
Parallax star	0.14	+ 12.7	+ 1.3	.....

The mean magnitude of the comparison stars is approximately 9.3.

TABLE 2

REDUCTIONS FOR ANONYMOUS (WOLF) 11^h6^m

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
392....	+0.458	1.0	−0.402	−626	−0.002	−0″.01
603....	+ .320	1.0	+ .891	−365	+ .004	+ .01
743....	+ .237	0.7	− .587	−247	− .006	− .01
1055....	+ .102	1.0	+ .842	+ 11	+ .002	.00
1077....	+ .084	0.4	+ .604	+ 37	.000	.00
1206....	+ .032	0.7	− .719	+130	+ .006	+ .01
1209....	+ .014	0.7	− .839	+144	− .004	− .01
1215....	+ .022	0.7	− .846	+145	+ .005	+ .01
1472....	− .112	0.7	+ .878	+369	− .007	− .02
1481A...	−0.124	0.4	+0.594	+403	+0.001	0.00

The normal equations are:

$$7.3\,c - 4.2530\,\mu + 0.3311\,\pi = +0.9991$$
$$+76.9815 \quad +1.3280 \quad = -4.8448$$
$$+4.0879 \quad = -0.0259$$

from which

$$c = +0.1033$$
$$\mu = -0.0573 = -0''.152 \qquad \mu_a = -0^s.037$$
$$\pi = +0.0039 = +0''.010 \pm 0''.004$$

Probable error corresponding to unit weight,

$$\pm 0.0030 = \pm 0''.008$$

Anonymous (12^h17^m, $+25°44'$)

This is a star of magnitude 10.7, discovered by Professor Max Wolf to have a proper motion of 0″.79 per year. See *Astronomische Nachrichten*, Vol. CLXXI (1906), p. 327. The plates were measured by Mr. Slocum.

TABLE 1

PLATES OF ANONYMOUS (WOLF) 12^h17^m

No.	Date	Hour Angle	Observers	Quality of Images
412.....	1911 May 6	−0h4	Su	Good[1]
672.....	1912 Feb. 18	−1.3	Sl, V, Su	Good[1]
763.....	May 18	0.0	Su, Sl	Good[1]
1044.....	Dec. 21	−0.2	Su, Sl	Poor[1]
1218.....	1913 May 17	+0.2	Sl	Good[1]
1228.....	May 31	+0.8	Su, M	Fair[1]
1235.....	June 1	+0.8	Su, Sl	Poor[1]
1482.....	1914 Jan. 31	−0.4	Su, Sl	Fair[1]

[1] One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−110	− 70	+0.234
2.....	.20	− 14	− 24	.243
3.....	.16	− 7	+216	.323
4.....	.23	+131	−122	+0.200
Parallax star...	0.18	− 5.3	+ 23.2	.....

The mean magnitude of the comparison stars is approximately 9.9.

TABLE 2

REDUCTIONS FOR ANONYMOUS (WOLF) 12^h17^m

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
412....	−0.161	0.7	−0.602	−490	+0.013	+0″.03
672....	.360	0.7	+ .528	−202	.000	.00
763....	.463	0.7	− .740	−112	− .018	− .04
1044....	.595	0.3	+ .900	+105	− .023	− .03
1218....	.688	0.7	− .728	+252	+ .015	+ .03
1228....	.721	0.5	− .844	+266	− .006	− .01
1235....	.726	0.3	− .851	+267	− .011	− .02
1482....	−0.851	0.5	+0.725	+511	+0.012	+0.02

The normal equations are:

$$4.4\,c + 1.1370\,\mu - 1.1242\,\pi = -2.3527$$
$$+44.0499 \quad +0.9459 \quad = -3.6916$$
$$+2.2824 \quad = +0.5457$$

from which

$$c = -0.5122$$
$$\mu = -0.0709 = -0''.189 \qquad \mu_a = -0^s.050$$
$$\pi = +0.0162 = +0''.043 \pm 0''.016$$

Probable error corresponding to unit weight,

$$\pm 0.0085 = \pm 0''.023$$

B.D. +18°2696 (13^h5^m, $+18°1'$)

This star appears on the plates taken for the parallax of 42 Comae Berenices. It was observed to have an appreciable proper motion, approximately 0″.12 per year, so four plates were measured by Mr. Slocum to get a rough value of its parallax.

TABLE 1

PLATES OF B.D. +18°2696

No.	Date	Hour Angle	Observers	Quality of Images
1225.....	1913 May 18	+0h4	Sl	Good
1499.....	1914 Feb. 15	−0.3	Su, Sl	Fair
1505.....	Feb. 26	+0.5	Su, Sl	Good
1593.....	May 30	+0.2	Su, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
2.....	0.11	−106	+233	+0.515
4.....	.16	+309	− 29	.184
7.....	.14	−203	−204	+0.301
Parallax star...	0.35	− 58.9	+ 53.3	.....

The mean magnitude of the comparison stars is approximately 10.5.

TABLE 2

REDUCTIONS FOR B.D. +18°2696

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
1225....	+0.046	0.7	−0.599	−234	0.000	0.00
1499....	.026	0.7	+ .708	+ 39	+ .001	.00
1505....	.024	1.0	+ .585	+ 50	− .001	.00
1593....	+0.022	1.0	−0.730	+143	0.000	0.00

The normal equations are:

$$\begin{aligned} 3.4\,c + 0.5650\,\mu - 0.0687\,\pi &= +0.0964 \\ +6.2343 \quad +0.4230 \quad &= -0.0248 \\ +1.4772 \quad &= -0.0084 \end{aligned}$$

from which

$$\begin{aligned} c &= +0.0294 \\ \mu &= -0.0065 = -0''.017 \qquad \mu_\alpha = -0^s.004 \\ \pi &= -0.0025 = \mathbf{-0''.007 \pm 0''.002} \end{aligned}$$

Probable error corresponding to unit weight,

$$\pm 0.0007 = \pm 0''.002$$

Oxford +25°46692 (16^h0^m, +25°30′)

This is a star of magnitude 7.5, with a proper motion of 0″.922, according to measures of the Oxford plates. See *Monthly Notices of the Royal Astronomical Society*, Vol. LXXII (1911), p. 71. The rotating disk was used to reduce the brightness of the parallax star by about two magnitudes. The plates were measured by Mr. Slocum.

TABLE 1

PLATES OF OXFORD +25°46692

No.	Date	Hour Angle	Observers	Quality of Images
694	1912 Mar. 5	−0h4	Sl, Su	Fair
699	Mar. 17	−0.6	V, Sl	Good
712	Mar. 21	−0.9	V, Sl	Good
790	June 22	−0.4	Su, M	Good[1]
799	June 29	+0.6	Su, M	Fair
1144	1913 Feb. 16	−0.1	Su, M	Good[1]
1276	June 26	+0.1	Su, M	Fair
1286	June 29	+0.3	Su, M	Fair[2]
1290	July 3	+0.2	Su, Su	Fair
1291	July 3	+0.4	Su	Good
1508	1914 Feb. 26	−0.6	Su, Sl	Good
1509	Feb. 26	−0.1	Su	Good
1533	Mar. 14	−0.7	Su, Sl	Good

[1] B rejected
[2] A rejected

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.10	−278	− 8	+0.185
2	.18	−147	+192	.280
3	.11	+ 30	−214	.105
4	.16	+187	− 13	.202
5	.21	+208	+ 43	+0.228
Parallax star	0.18	− 4.0	+ 36.8	.....

The mean magnitude of the comparison stars is approximately 9.6.

TABLE 2

REDUCTIONS FOR OXFORD +25°46692

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
694	+0.708	0.7	+0.947	−363	+0.015	+0″.03
699	.684	1.0	+ .883	−351	− .001	.00
712	.680	1.0	+ .853	−347	− .002	− .01
790	.593	0.7	− .484	−254	− .012	− .03
799	.596	0.7	− .582	−247	− .004	− .01
1144	.502	0.7	+ .966	− 15	− .004	− .01
1276	.382	0.7	− .538	+115	− .024	− .05
1286	.421	0.5	− .579	+118	+ .018	+ .03
1290	.424	0.7	− .632	+122	+ .024	+ .05
1291	.401	0.7	− .632	+122	+ .001	.00
1508	.298	1.0	+ .966	+360	− .006	− .01
1509	.303	0.7	+ .966	+360	− .001	.00
1533	+0.296	1.0	+0.905	+376	+0.002	+0.01

The normal equations are:

$$\begin{aligned} 10.1\,c - 0.1500\,\mu + 3.3252\,\pi &= +4.9048 \\ +82.2626 \quad +0.7604 \quad &= -4.4872 \\ +6.5242 \quad &= +1.6790 \end{aligned}$$

from which

$$\begin{aligned} c &= +0.4783 \\ \mu &= -0.0539 = -0''.143 \qquad \mu_\alpha = -0^s.039 \\ \pi &= +0.0199 = \mathbf{+0''.053 \pm 0''.009} \end{aligned}$$

Probable error corresponding to unit weight,

$$\pm 0.0077 = \pm 0''.020$$

B.D. +42°2810 (17^h10^m, +42°28′)

This is a faint star with large proper motion. Its magnitude is 9.4 in the *Bonner Durchmusterung*, corresponding to approximately 10.0 on the Harvard scale. Its proper motion is given as 1″.11 in the *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg*, February 14, 1912, p. 302. Twelve plates were measured by Mr. Slocum.

TABLE 1

PLATES OF B.D. +42°2810

No.	Date	Hour Angle	Observers	Quality of Images
701	1912 Mar. 17	−0h4	Sl, Su	Good
726	April 2	−0.7	Sl, V	Good
800	June 29	+0.1	M	Good
808	July 7	−1.0	Su, Sl	Good
1160	1913 Mar. 8	−1.8	Su, Sl	Fair
1169	Mar. 9	−1.6	Su, M	Good
1174	Mar. 16	−1.2	Su, M	Good
1310	July 12	0.0	Su, O	Good
1316	July 20	−1.1	Su, T	Fair
1325	July 26	−0.7	Su, T	Fair
1528	1914 Mar. 12	−0.4	Su, Sl	Good
1539	Mar. 19	−0.7	Su, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.12	−295	+186	+0.103
2.....	.22	− 36	− 53	.266
3.....	.24	− 7	−292	.381
4.....	.10	+338	+159	+0.250
Parallax star...	0.21	+ 41.8	− 66.6	.....

The mean magnitude of the comparison stars is approximately 10.6.

TABLE 2

REDUCTIONS FOR B.D. +42°2810

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
701....	−0.162	1.0	+0.980	−353	+0.010	+0″.03
726....	.184	1.0	+ .906	−337	+ .005	+ .01
800....	.281	0.7	− .337	−249	+ .005	+ .01
808....	.303	1.0	− .460	−241	− .008	− .02
1160....	.545	0.7	+ .989	+ 3	− .001	.00
1169....	.568	1.0	+ .990	+ 4	− .023	− .06
1174....	.550	1.0	+ .983	+ 11	+ .002	+ .01
1310....	.686	1.0	− .530	+129	− .004	− .01
1316....	.679	0.7	− .639	+137	+ .012	+ .03
1325....	.698	0.7	− .713	+143	− .001	.00
1528....	.912	1.0	+ .989	+372	+ .017	+ .05
1539....	−0.944	1.0	+0.976	+379	−0.008	−0.02

The normal equations are:

$$10.8\,c - 0.1220\,\mu + 4.3440\,\pi = -5.8511$$
$$+66.5922 \quad +0.7198 \quad = -6.8879$$
$$+7.5567 \quad = -2.4077$$

from which

$$c = -0.5448$$
$$\mu = -0.1045 = -0''.278 \qquad \mu_a = -0^s.092$$
$$\pi = +0.0045 = +0''.012 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0.0078 = \pm 0''.021$$

4, 5 ϵ Lyrae (18^h41^m, 39°32′)

This is the well-known double double in Lyra. According to Auwers the two pairs ϵ^1 and ϵ^2 have practically the same proper motion, but there has been no appreciable relative change. Each pair, however, shows revolution. In ϵ^1 the position-angle is changing about 20° per century, and in ϵ^2 approximately twice that amount. The pairs are so situated that they can both be placed behind the rotating disk at the same time. The magnitudes of the four components range from 4.9 to 6.7, and, after reduction by the occulting device, the diameters of the images range from 0.12 mm to 0.21 mm. The components are well separated on the plates, so that all four can easily be measured. Fifteen plates were secured, and were measured by Mr. Mitchell.

TABLE 1

PLATES OF ϵ LYRAE

No.	Date	Hour Angle	Observers	Quality of Images
17.....	1907 Aug. 24	−0h6	Su, J, Su	Fair–Poor
400.....	1911 April 8	−1.2	Su, Si	Fair
458.....	Aug. 5	−0.2	Su, Si	Fair–Good
473.....	Aug. 26	−0.7	Su, Su	Fair
751.....	1912 April 14	−1.2	V, Su	Poor
757.....	April 23	−1.3	Su, Si	Good
868.....	Aug. 25	−0.1	Su, Si	Fair–Good
876.....	Sept. 1	−0.2	Su, M	Good
879.....	Sept. 7	−0.3	M, M	Fair
1153.....	1913 Mar. 6	−2.2	Su, M	Good
1184.....	April 5	−1.3	Su, Si	Fair
1185.....	April 5	−0.8	Su, Si	Fair–Good
1190.....	April 6	−1.2	Su, M	Fair
1191.....	April 6	−0.7	Su, M	Fair
1197.....	April 13	−1.0	Su, M	Poor

COMPARISON STARS FOR 4 ϵ^1 LYRAE

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.32	−222	− 30	+0.292
2.....	.14	−156	−151	.206
5.....	.21	+168	+321	.387
6.....	.26	+210	−140	+0.115
Preceding star..	.21	− 7.9	− 67.8	.....
Following star..	0.12	− 7.7	+ 68.9	.....

COMPARISON STARS FOR 5 ϵ^2 LYRAE

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.32	−222	− 30	+0.242
2.....	.14	−156	−151	.255
5.....	.21	+168	+321	.231
6.....	.26	+210	−140	+0.272
Preceding star..	.18	+ 1.9	− 9.5	.....
Following star..	0.19	+ 2.6	− 10.0	.....

The mean magnitude of the comparison stars is approximately 9.9.

TABLE 2

REDUCTIONS FOR 4 ϵ^1 LYRAE, PRECEDING

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
17....	−0.026	0.7	−0.786	−1694	+0.001	0″.00
400....	.029	0.7	+ .987	− 371	.000	.00
458....	.027	0.7	− .552	− 252	+ .001	.00
473....	.036	0.7	− .807	− 231	− .008	− .02
751....	.042	0.4	+ .964	+ 1	− .012	− .02
757....	.022	1.0	+ .914	+ 10	+ .008	+ .02
868....	.028	1.0	− .804	+ 134	.000	.00
876....	.034	1.0	− .869	+ 141	− .006	− .02
879....	.013	0.7	− .914	+ 147	+ .015	+ .03
1153....	.037	1.0	+ .910	+ 327	− .007	− .02
1184....	.029	0.7	+ .992	+ 357	+ .001	.00
1185....	.026	0.7	+ .992	+ 357	+ .004	+ .01
1190....	.018	0.7	+ .990	+ 358	+ .012	+ .03
1191....	.038	0.7	+ .990	+ 358	− .008	− .02
1197....	−0.034	0.4	+0.970	+ 365	−0.004	−0.01

The normal equations are:

$$11.1\,c + 0.7870\,\mu + 2.2490\,\pi = -0.3208$$
$$+275.8040 \quad +20.1997 = -0.0602$$
$$+8.9313 = -0.0748$$

from which

$$c = -0.0287$$
$$\mu = -0.0001 = 0''.000 \qquad \mu_a = 0^s.000$$
$$\pi = -0.0010 = \mathbf{-0''.003 \pm 0''.005}$$

Probable error corresponding to unit weight,

$$\pm 0.0047 = \pm 0''.012$$

TABLE 3

REDUCTIONS FOR 4 ϵ^1 LYRAE, FOLLOWING

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
17....	+0.202	0.7	−0.786	−1694	+0.006	+0''.01
400....	.166	0.7	+ .987	−.371	− .012	− .03
458....	.195	0.7	− .552	−.252	+ .014	+ .03
473....	.156	0.7	− .807	− 231	− .025	− .06
751....	.161	0.4	+ .964	+ 1	− .013	− .02
757....	.181	1.0	+ .914	+ 10	+ .007	+ .02
868....	.173	1.0	− .804	+ 134	− .004	− .01
876....	.170	1.0	− .869	+ 141	− .007	− .02
879....	.199	0.7	− .914	+ 147	+ .022	+ .05
1153....	.173	1.0	+ .910	+ 327	+ .002	+ .01
1184....	.155	0.7	+ .992	+ 357	− .015	− .03
1185....	.158	0.7	+ .992	+ 357	− .012	− .03
1190....	.188	0.7	+ .990	+ 358	+ .018	+ .04
1191....	+0.198	0.4	+0.990	+ 358	+0.028	+0.05

The normal equations are:

$$10.4\,c - 1.7470\,\mu + 1.5640\,\pi = +1.8339$$
$$+266.6301 \quad +17.7202 = -0.6251$$
$$+8.2609 = +0.2369$$

from which

$$c = +0.1765$$
$$\mu = -0.0010 = -0''.003 \qquad \mu_a = -0^s.001$$
$$\pi = -0.0026 = \mathbf{-0''.007 \pm 0''.009}$$

Probable error corresponding to unit weight,

$$\pm 0.0092 = \pm 0''.024$$

TABLE 4

REDUCTIONS FOR 5 ϵ^2 LYRAE, PRECEDING

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
17....	−0.536	0.7	−0.786	−1694	−0.001	0''.00
400....	.558	0.7	+ .987	− 371	− .027	− .06
458....	.507	0.7	− .552	− 252	+ .027	+ .06
473....	.519	0.7	− .807	− 231	+ .016	+ .04
751....	.512	0.4	+ .964	+ 1	+ .019	+ .03
757....	.530	1.0	+ .914	+ 10	+ .001	.00
868....	.540	1.0	− .804	+ 134	− .005	− .01
876....	.558	1.0	− .869	+ 141	− .023	− .06
879....	.534	0.7	− .914	+ 147	+ .001	.00
1153....	.530	1.0	+ .910	+ 327	+ .001	.00
1184....	.549	0.7	+ .992	+ 357	− .018	− .04
1185....	.508	0.7	+ .992	+ 357	+ .023	+ .05
1190....	.531	0.7	+ .990	+ 358	.000	.00
1191....	.536	0.4	+ .990	+ 358	− .005	− .01
1197....	−0.519	0.4	+0.970	+ 365	+0.012	+0.02

The normal equations are:

$$10.8\,c - 0.2870\,\mu + 1.9520\,\pi = -5.7542$$
$$+271.9591 \quad +19.1364 = +0.1932$$
$$+8.6373 = -1.0206$$

from which

$$c = -0.5332$$
$$\mu = 0.0000 = 0''.000 \qquad \mu_a = 0^s.000$$
$$\pi = +0.0024 = \mathbf{+0''.006 \pm 0''.010}$$

Probable error corresponding to unit weight,

$$\pm 0.0099 = \pm 0''.026$$

TABLE 5

REDUCTIONS FOR 5 ϵ^2 LYRAE, FOLLOWING

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
17....	+0.138	0.7	−0.786	−1694	−0.010	−0''.02
400....	.168	0.7	+ .987	− 371	+ .010	+ .02
458....	.144	0.7	− .552	− 252	− .007	− .02
473....	.158	0.7	− .807	− 231	+ .008	+ .02
751....	.174	0.4	+ .964	+ 1	+ .015	+ .03
757....	.176	1.0	+ .914	+ 10	+ .018	+ .05
868....	.155	1.0	− .804	+ 134	+ .004	+ .01
876....	.158	1.0	− .869	+ 141	+ .007	+ .02
879....	.143	0.7	− .914	+ 147	− .008	− .02
1153....	.140	1.0	+ .910	+ 327	− .019	− .05
1184....	.176	0.7	+ .992	+ 357	+ .017	+ .04
1185....	.143	0.7	+ .992	+ 357	− .016	− .04
1190....	.158	0.7	+ .990	+ 358	− .001	.00
1191....	.131	0.4	+ .990	+ 358	− .028	− .05
1197....	+0.163	0.4	+0.970	+ 365	+0.004	+0.01

The normal equations are:

$$10.8\,c - 0.2870\,\mu + 1.9520\,\pi = +1.6758$$
$$+271.9591 \quad +19.1364 = +0.0902$$
$$+8.6373 = +0.3433$$

from which

$$c = +0.1544$$
$$\mu = +0.0002 = +0''.001 \qquad \mu_a = 0.000$$
$$\pi = +0.0045 = \mathbf{+0''.012 \pm 0''.008}$$

Probable error corresponding to unit weight,

$$\pm 0.0083 = \pm 0''.022$$

SUMMARY

ϵ^1 preceding, $\pi = -0''.003 \pm 0''.005$
ϵ^1 following, $\pi = -0.007 \pm 0.009$
ϵ^2 preceding, $\pi = +0.006 \pm 0.010$
ϵ^2 following, $\pi = +0.012 \pm 0.008$

B.D. +18°3911 (18^h56^m, +18°57′)

This is a star of magnitude 9.5, with a proper motion of 0″.58. Twelve plates were measured by Mr. Slocum.

TABLE 1

PLATES OF B.D. +18°3911

No.	Date	Hour Angle	Observers	Quality of Images
257	1910 June 18	−1h0	Sl, Sl	Good
419	1911 May 6	−1.1	Su, Sl	Good
451	July 29	−0.1	Su	Good
474	Aug. 26	−0.2	Su, Su	Good
769	1912 May 18	−1.2	Su, Sl	Fair
853	Aug. 11	+0.2	Su, Sl	Good
914	Sept. 22	+0.1	Sl, M	Good
1211	1913 May 10	−1.2	Su, Sl	Fair
1361	Sept. 13	+0.3	Su, Sl	Fair
1373	Sept. 14	+0.2	Su, Sl	Good
1578	1914 May 3	−0.1	Su, Sl	Good
1580	May 13	−0.7	Su, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.14	−392	+ 37	+0.234
2	.14	−108	−309	.202
3	.22	+ 62	+190	.199
4	.21	+ 97	− 22	.191
5	.45	+341	+104	+0.174
Parallax star	0.23	− 23.6	− 2.1	.....

The mean magnitude of the comparison stars is approximately 9.8.

TABLE 2

REDUCTIONS FOR B.D. +18°3911

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
257	−0.258	1.0	+0.279	−811	+0.009	+0″.02
419	.348	1.0	+ .846	−489	.000	.00
451	.405	0.7	− .392	−405	− .031	− .07
474	.382	1.0	− .766	−377	.000	.00
769	.440	0.7	+ .714	−111	+ .006	+ .01
853	.458	1.0	− .592	− 26	+ .014	+ .04
914	.484	1.0	− .971	+ 16	.000	.00
1211	.550	0.7	+ .804	+246	− .012	− .03
1361	.571	0.7	− .925	+372	+ .005	+ .01
1373	.579	1.0	− .931	+373	− .003	− .01
1578	.616	1.0	+ .869	+604	+ .014	+ .04
1580	−0.646	1.0	+0.775′	+614	−0.013	−0.03

The normal equations are:

$$10.8\,c - 0.2460\,\mu - 0.3503\,\pi = -5.1472$$
$$+218.3516 \quad +2.5537 = -5.5148$$
$$+6.4120 = +0.1218$$

from which

$$c = -0.4771$$
$$\mu = -0.0258 = -0''.069 \qquad \mu_a = -0^s.018$$
$$\pi = +0.0032 = +0''.009 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0.0086 = \pm 0''.023$$

16 Cygni (19^h39^m, +50°18′)

This is a double star of the type of 61 Cygni. The components are nearly equal in brightness, 6.2 and 6.3. They are separated by 38″, and have nearly the same proper motion, about 0″.20 per year. The distance and position-angle are such that both stars can be placed behind the occulting disk at the same time. The plates were measured by Mr. Mitchell.

TABLE 1

PLATES OF 16 CYGNI

No.	Date	Hour Angle	Observers	Quality of Images
420	1911 May 6	−1h2	Su, Sl	Good
459	Aug. 5	−0.5	Su	Good
475	Aug. 26	−0.2	Su, Su	Good
759	1912 April 23	−1.2	Su, Sl	Good
771	May 18	−0.8	Su, Sl	Good
869	Aug. 25	−0.4	Su, Sl	Good
877	Sept. 1	−0.2	M, Su	Good
881	Sept. 7	0.0	Su, M	Fair
915	Sept. 22	0.0	Sl, Su	Good
924	Sept. 29	−0.4	Sl	Good
1198	1913 April 13	−1.4	Su, M	Fair
1212	May 10	−1.3	Su, Sl	Fair
1213	May 10	−0.9	Su, Sl	Fair
1219	May 17	−1.5	Sl, M	Good
1220	May 17	−1.2	Sl, M	Good

COMPARISON STARS FOR PRECEDING STAR

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.16	−235	+106	+0.225
2	.42	−153	−212	.234
3	.24	+ 19	+161	.187
4	.27	+182	+185	.164
5	.26	+187	−240	+0.190
Parallax star	0.22	− 20.0	− 10.9	.....

COMPARISON STARS FOR FOLLOWING STAR

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.16	−235	+106	+0.203
2	.42	−153	−212	.236
3	.24	+ 19	+161	.179
4	.27	+182	+185	.165
5	.26	+187	−240	+0.217
Parallax star	0.18	− 9.8	− 21.0	.....

The mean magnitude of the comparison stars is about 9.5.

TABLE 2

REDUCTIONS FOR 16 CYGNI, PRECEDING STAR

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
420	−0.138	1.0	+0.918	−471	−0.001	0″.00
459	.172	0.7	− .335	−380	+ .001	.00
475	.168	1.0	− .636	−359	+ .013	+ .03
759	.197	1.0	+ .974	−118	− .003	− .01
771	.218	1.0	+ .818	− 93	− .017	− .05
869	.218	1.0	− .633	+ 6	+ .022	+ .06
877	.250	1.0	− .718	+ 13	− .007	− .02
881	.236	0.7	− .783	+ 19	+ .009	+ .02
915	.256	1.0	− .908	+ 34	− .006	− .02
924	.283	0.7	− .946	+ 41	− .032	− .07
1198	.240	0.7	+ .989	+237	+ .012	+ .03
1212	.258	0.7	+ .887	+264	.000	.00
1213	.257	0.7	+ .887	+264	+ .001	.00
1219	.263	1.0	+ .829	+271	− .003	− .01
1220	−0.251	1.0	+0.829	+271	+0.009	+0.02

The normal equations are:

$$13.2\,c - 1.3450\,\mu + 1.9623\,\pi = -2.9712$$
$$+76.0940 \quad +5.5371 \quad = -0.8422$$
$$+8.9005 \quad = -0.3950$$

from which

$$c = -0.2292$$
$$\mu = -0.0163 = -0''.043 \qquad \mu_\alpha = -0^s.016$$
$$\pi = +0.0163 = +0''.043 \pm 0''.008$$

Probable error corresponding to unit weight,

$$\pm 0.0088 = \pm 0''.023$$

TABLE 3

REDUCTIONS FOR 16 CYGNI, FOLLOWING STAR

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
420....	+0.140	1.0	+0.918	−471	+0.014	+0''.04
459....	.094	0.7	− .335	−380	− .005	− .01
475....	.110	1.0	− .636	−359	+ .018	+ .05
750....	.057	1.0	+ .974	−118	− .016	− .04
771....	.036	1.0	+ .818	− 93	− .031	− .08
869....	.030	1.0	− .633	+ 6	− .007	− .02
877....	.044	1.0	− .718	+ 13	+ .009	+ .03
881....	.046	0.7	− .783	+ 19	+ .013	+ .03
915....	.010	1.0	− .908	+ 34	− .019	− .05
924....	.023	0.7	− .946	+ 41	− .005	− .01
1198....	.032	0.7	+ .989	+237	+ .014	+ .03
1212....	.020	0.7	+ .887	+264	+ .007	+ .02
1213....	.020	0.7	+ .887	+264	+ .007	+ .02
1219....	.019	1.0	+ .829	+271	+ .008	+ .02
1220....	+0.014	1.0	+0.829	+271	+0.002	+0.01

The normal equations are:

$$13.2\,c - 1.3450\,\mu + 1.9623\,\pi = +0.6245$$
$$+76.0940 \quad +5.5371 \quad = -1.1650$$
$$+8.9005 \quad = +0.0957$$

from which

$$c = +0.0442$$
$$\mu = -0.0153 = -0''.041 \qquad \mu_\alpha = -0^s.016$$
$$\pi = +0.0105 = +0''.028 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0.0100 = \pm 0''.027$$

For the mean of the two stars Jost has found by meridian circle observations $\pi = +0''.153 \pm 0''.031$.

3 η Cephei (20^h43^m, $+61°27'$)

This is a bright K-type star with large proper motion, 0''.82 per year, and large radial velocity, −87 km per second. The rotating disk was used. Fifteen plates were measured by Mr. Slocum.

TABLE 1

PLATES OF 3 η CEPHEI

No.	Date	Hour Angle	Observers	Quality of Images
298.....	1910 Sept. 9	−0h6	Su, Su	Poor
312.....	Oct. 8	−0.2	Sl, Su	Fair
429.....	1911 June 17	−1.7	Su, Sl	Good
512.....	Sept. 23	−0.4	Su, Sl	Good
527.....	Oct. 14	−1.0	Sl, Sl	Good
762.....	1912 May 16	−1.4	Su, Sl	Good
776.....	June 8	−1.2	Sl	Good
783.....	June 9	−1.0	M, Su	Fair
940.....	Oct. 12	−0.1	M, Sl	Good
959.....	Oct. 26	−0.6	M, Sl	Good
965.....	Oct. 27	−0.6	Sl, M	Good
1214.....	1913 May 10	−1.5	Su, Sl	Poor
1221.....	May 17	−1.9	Sl, M	Fair
1222.....	May 17	−1.5	Sl, M	Fair
1233.....	May 31	−0.6	Su, Sl	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.12	−421	−202	+0.191
2.....	.25	−154	−299	.168
3.....	.22	− 42	+156	.175
4.....	.16	+190	− 32	.152
5.....	.17	+193	+238	.160
6.....	.22	+234	+139	+0.154
Parallax star...	0.30	− 18.0	− 6.9	.....

The mean magnitude of the comparison stars is approximately 10.0.

TABLE 2

REDUCTIONS FOR 3 η CEPHEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
298....	−0.210	0.4	−0.599	−638	+0.019	+0''.03
312....	.229	0.7	− .884	−609	+ .004	+ .01
429....	.150	1.0	+ .663	−357	+ .019	+ .05
512....	.228	1.0	− .758	−259	− .033	− .09
527....	.200	1.0	− .916	−238	− .004	− .01
762....	.133	1.0	+ .931	− 23	− .004	− .01
776....	.136	0.7	+ .755	0	− .005	− .01
783....	.144	0.7	+ .744	+ 1	− .013	− .03
940....	.164	1.0	− .910	+126	− .004	− .01
959....	.157	1.0	− .955	+140	+ .002	+ .01
965....	.134	1.0	− .956	+141	+ .025	+ .07
1214....	.076	0.4	+ .955	+336	+ .016	+ .03
1221....	.088	0.7	+ .927	+343	+ .004	+ .01
1222....	.104	0.7	+ .927	+343	− .012	− .03
1233....	−0.093	0.7	+0.832	+357	0.000	0.00

The normal equations are:

$$12.0\,c - 2.8630\,\mu - 0.4479\,\pi = -1.8362$$
$$+102.8576 \quad +10.8472 \quad = +1.7328$$
$$+ 8.9035 \quad = +0.3974$$

from which

$$c = -0.1497$$
$$\mu = +0.0101 = +0''.027 \qquad \mu_\alpha = +0^s.014$$
$$\pi = +0.0249 = +0''.066 \pm 0''.010$$

Probable error corresponding to unit weight,

$$\pm 0.0101 = \pm 0''.027$$

Other results are:

$\pi = +0''.088 \pm 0''.037$, Smith with heliometer

$\pi = +0''.241 \pm 0''.028$, Abetti with meridian circle

Y Cygni (20^h48^m, $+34°17'$)

This is a short-period eclipsing variable in which both components are bright, giving, therefore, two minima in each complete revolution of 20 hours. The brightness varies from the seventh to the eighth magnitude. The rotating disk was used. Fourteen plates were measured by Mr. Mitchell.

TABLE 1

PLATES OF Y CYGNI

No.	Date	Hour Angle	Observers	Quality of Images
285	1910 Aug. 20	+0h2	Su, Sl	Good
305	Oct. 1	−0.1	Su, Sl	Good
476	1911 Aug. 26	−0.5	Su, V	Good
533	Oct. 28	−0.6	Sl, Sl	Good
777	1912 June 8	−0.7	Su, Sl	Good
916	Sept. 22	−0.2	Su, Sl	Good
972	Nov. 2	−0.2	Sl, Sl	Good
1223	1913 May 17	−1.2	Sl, M	Fair
1234	May 31	−0.3	Su, Sl	Poor
1240	June 1	−0.7	Su, M	Good
1241	June 1	−0.3	Su, M	Fair–Good
1249	June 7	−0.2	Su, Sl	Poor
1254	June 8	−0.4	Su, M	Poor
1255	June 8	0.0	Su, M	Poor

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.16	−235	+176	+0.175
2	.14	−278	−111	.155
3	.16	− 10	−202	.153
4	.21	+ 38	+186	.180
5	.27	+167	+186	.182
6	.26	+318	−235	+0.155
Parallax star	0.15	+ 0.8	+ 13.4	.....

The mean magnitude of the comparison stars is approximately 10.7.

TABLE 2

REDUCTIONS FOR Y CYGNI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ In Arc
285	+0.016	1.0	−0.294	−728	0.000	0''.00
305	+ .012	1.0	− .821	−686	− .003	− .01
476	+ .009	1.0	− .382	−357	− .003	− .01
533	+ .006	1.0	− .953	−294	− .005	− .01
777	+ .026	1.0	+ .766	− 70	+ .017	+ .05
916	.000	1.0	− .741	+ 36	− .007	− .02
972	+ .022	1.0	− .956	+ 77	+ .016	+ .04
1223	− .006	0.7	+ .932	+273	− .011	− .02
1234	+ .021	0.4	+ .841	+287	+ .016	+ .03
1240	.000	1.0	+ .833	+288	− .004	− .01
1241	+ .014	0.8	+ .833	+288	+ .010	+ .02
1249	− .021	0.4	+ .778	+294	− .025	− .04
1254	− .012	0.4	+ .768	+295	− .016	− .03
1255	+0.003	0.4	+0.768	+295	−0.001	0.00

The normal equations are:

$$11.1\,c - 8.4410\,\mu + 0.0328\,\pi = +0.0944$$
$$+156.5202 + 20.1911 = -0.2402$$
$$+ 6.7183 = -0.0216$$

from which

$$c = +0.0076$$
$$\mu = -0.0011 = -0''.003 \qquad \mu_a = -0^s.001$$
$$\pi = +0.0002 = +0''.001 \pm 0''.010$$

Probable error corresponding to unit weight,

$$\pm 0.0073 \pm 0''.019$$

61 Cygni (21^h2^m, $+38°15'$)

This pair was put upon the program because of its historic interest. Both stars were reduced about $3\frac{1}{2}$ magnitudes by the rotating disk. Fourteen plates were measured by Mr. Slocum.

TABLE 1

PLATES OF 61 CYGNI

No.	Date	Hour Angle	Observers	Quality of Images
515	1911 Oct. 7	−0h4	Su, V	Fair
534	Oct. 28	−0.3	Sl, Sl	Fair
778	1912 June 8	−0.7	Su, Sl	Good
785	June 9	−0.3	M, Su	Good
960	Oct. 26	−0.1	Sl, M	Good
966	Oct. 27	−0.3	Sl, M	Good
982	Nov. 9	−0.2	Sl, M	Good
1259	1913 June 12	−0.8	Su, M	Fair
1263	June 21	−0.6	Su, Sl	Good
1264	June 21	−0.3	Su, Sl	Fair
1270	June 22	−0.6	Su, M	Good
1271	June 22	−0.3	Su, M	Fair
1391	Oct. 5	−0.9	Sl, Sl	Good
1420	Nov. 1	−0.7	Sl, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence	
				61_1	61_2
	mm				
1	0.18	−329	− 58	+0.178	+0.173
2	.18	−242	+262	.173	.162
3	.29	−185	−259	.175	.178
4	.19	+231	−240	.161	.171
5	.23	+246	+ 21	.158	.162
6	.23	+279	+274	+0.155	+0.154
Parallax star 61_1	.27	− 13.4	− 3.5	.....	.....
Parallax star 61_2	0.22	− 6.6	− 8.9	.....	.....

The mean magnitude of the comparison stars is approximately 9.9.

TABLE 2

REDUCTIONS FOR 61 CYGNI

Plate	Solution (m_1)	Solution (m_2)	Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p.v}$ in Arc 61_1	$\sqrt{p.v}$ in Arc 61_2
515...	−1.540	−1.500	0.7	−0.832	−448	+0″.03	−0″.01
534...	−1.480	−1.424	0.7	− .941	−427	− .01	− .01
778...	−0.360	−0.291	1.0	+ .799	−203	+ .01	+ .02
785...	−0.309	−0.310	1.0	+ .789	−202	− .03	− .04
960...	+0.044	+0.118	1.0	− .938	− 63	− .02	+ .03
966...	+0.051	+0.120	1.0	− .940	− 62	− .01	+ .02
982...	+0.108	+0.166	1.0	− .947	− 49	.00	.00
1259...	+1.182	+1.256	0.7	+ .762	+166	.00	+ .02
1263...	+1.217	+1.287	1.0	+ .664	+175	+ .02	+ .04
1264...	+1.218	+1.263	0.7	+ .664	+175	+ .02	− .02
1270...	+1.214	+1.281	1.0	+ .652	+176	.00	+ .01
1271...	+1.208	+1.263	0.7	+ .652	+176	− .01	− .03
1391...	+1.512	+1.562	1.0	− .820	+281	+ .01	− .01
1420...	+1.605	+1.654	1.0	−0.948	+308	−0.01	−0.03

The normal equations for 61_1 and 61_2 are:

		61_1	61_2
$12.5c$	$+1.1040\mu - 1.4755\pi$	$= +5.4336$,	$+6.1876$
$+65.8186$	$+3.4314$	$= +28.4294$,	$+28.5002$
	$+8.4753$	$= +1.6877$,	$+1.6282$

from which

61_1	61_2
$c = +0.4095$	$+0.4702$
$\mu = +0.4198 = +1″.117$	$+0.4197 = +1″.116$
$\mu_a = +0″.346$	$\mu_a = +0″.346$
$\pi = +0.1004 =$	$+0.1041 =$
$+0″.267 \pm 0″.004$	$+0″.277 \pm 0″.006$

Probable error corresponding to unit weight,

$(61_1) \quad \pm 0.0043 = \pm 0″.011$

$(61_2) \quad \pm 0.0063 = \pm 0″.017$

No star has received more attention from parallax observers than 61 Cygni. Its parallax has been determined by a great variety of methods and by instruments of various sizes and types. A complete list of the results naturally shows a marked discordance. In fact, the values range from $\pi = +0″.20$ to $\pi = +0″.55$.

The following list gives some of the more recent results obtained by the different methods. All are for the mean of 61_1 and 61_2 except the last, which is for 61_1 only.

Parallax	Observer	Method
+0″.326 ± 0″.035	Donner-Kapteyn	Photography
.291 ± .005	Chase	Heliometer
.293 ± .007	Bergstrand	Photography
.292 ± .024	Abetti	Meridian Circle
.38 ± .015	Kostinsky	Photography
.21 ± .029	Flint	Meridian Circle
.270 ± .010	A. Hall	Micrometer
.320 ± .028	Jost	Meridian Circle
.384 ± .021	Russell	Photography
.301 ± .010	Miller	Photography
.272 ± .005	Slocum	Photography
+0.309 ± 0.013	H. Struve	Micrometer

It is interesting to note that Bessel's first result obtained with the Königsberg heliometer in 1838 is $\pi = +0″.3136$.

23 ε Cephei (22^h11^m, $+56°33'$)

This is a bright A-type star with large proper motion, 0″.46 per year. The rotating disk was used to reduce it about five magnitudes. Eight plates were measured by Mr. Mitchell.

TABLE 1

PLATES OF 23 ε CEPHEI

No.	Date	Hour Angle	Observers	Quality of Images
269.....	1910 June 25	−1h8	Su, Sl	Good
320.....	Oct. 15	−0.1	Su, Sl	Fair
329.....	Oct. 22	−0.4	Su, Sl	Good
566.....	1911 Dec. 5	0.0	Sl, V	Good
795.....	1912 June 22	−0.6	Su, Sl	Good
798.....	June 23	−0.7	Su	Good
805.....	June 30	−1.0	Su, M	Poor
1020.....	Dec. 8	0.0	M, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−330	+ 62	+0.206
2.....	.26	−187	+ 97	.188
3.....	.17	− 60	−138	.238
4.....	.18	+236	− 77	.204
5.....	.19	+341	+ 56	+0.164
Parallax star...	0.27	− 13.1	− 8.5	.....

The mean magnitude of the comparison stars is approximately 9.7.

TABLE 2

REDUCTIONS FOR 23 ε CEPHEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (s)	$\sqrt{p.v}$ in Arc
269....	+0.242	1.0	+0.797	−481	+0.011	+0″.03
320....	.233	0.7	− .725	−369	− .013	− .03
329....	.240	1.0	− .789	−362	− .007	− .02
566....	.436	1.0	− .902	+ 47	+ .012	+ .03
795....	.551	1.0	+ .817	+247	.000	.00
798....	.540	0.8	+ .809	+248	− .011	− .03
805....	.552	0.4	+ .746	+255	− .001	.00
1020....	+0.590	1.0	−0.886	+416	+0.003	+0.01

The normal equations are:

$$6.9c - 0.9090\mu - 0.5249\pi = +2.8749$$
$$+76.9205 \quad +1.1696 = +3.0200$$
$$+4.6379 = -0.0664$$

from which

$c = +0.4242$

$\mu = +0.0439 = +0″.117 \qquad \mu_a = +0″.052$

$\pi = +0.0226 = +0″.060 \pm 0″.009$

Probable error corresponding to unit weight,

$$\pm 0.0070 = \pm 0″.019$$

With the heliometer Smith has found

$$\pi = +0″.110 \pm 0″.015$$

B.D. +28°4562 (23^h15^m, +28°19′)

This is No. 68247 in the Oxford photographic zone +29°. According to measures of the Oxford plates it has a proper motion of 0″.754 per year. See *Monthly Notices of the Royal Astronomical Society*, Vol. LXXI (1911), p. 584. The plates were measured by Mr. Slocum.

TABLE 1

PLATES OF B.D. +28°4562

No.	Date	Hour Angle	Observers	Quality of Images
499	1911 Sept. 16	−0h1	V, Sl	Fair[1]
518	Oct. 7	−0.4	Su, V	Fair
549	Nov. 21	−0.1	V, Sl	Good
568	Dec. 5	−0.2	V, Sl	Good
824	1912 July 21	−0.5	Su, M	Good
828	July 28	−0.7	M, Su	Poor
833	July 29	−1.9	Su, M	Fair
952	Oct. 19	−0.3	Su	Good
963	Oct. 26	−0.2	M, Su	Fair
998	Nov. 16	0.0	M, Su	Good
1297	1913 July 5	−1.3	Su, M	Fair
1298	July 5	−0.7	Su, M	Fair
1319	July 20	−0.8	M, Su	Good
1320	July 20	−0.2	M, Su	Good

[1] One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.21	−268	− 28	+0.163
2	.14	−106	+228	.272
3	.34	+ 41	−177	.221
4	.35	+333	− 23	+0.344
Parallax star	0.32	+ 51.0	+ 10.5	.....

The mean magnitude of the comparison stars is approximately 9.0.

TABLE 2

REDUCTIONS FOR B.D. +28°4562

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
499	−0.287	0.5	−0.085	−357	+0.014	+0″.03
518	− .302	0.7	− .400	−336	− .011	− .02
549	− .251	1.0	− .858	−291	+ .016	+ .04
568	− .268	1.0	− .903	−277	− .011	− .03
824	− .048	1.0	+ .703	− 48	+ .002	+ .01
828	− .072	0.4	+ .627	− 41	− .025	− .04
833	− .050	0.7	+ .616	− 40	− .004	− .01
952	+ .007	0.7	− .570	+ 42	+ .015	+ .03
963	− .008	0.7	− .651	+ 49	− .003	− .01
998	.000	1.0	− .834	+ 70	− .007	− .02
1297	+ .232	0.7	+ .843	+301	+ .015	+ .03
1298	+ .230	0.7	+ .843	+301	+ .013	+ .03
1319	+ .219	1.0	+ .716	+316	− .007	− .02
1320	+0.218	1.0	+0.716	+316	−0.008	−0.02

The normal equations are:

$$11.1\,c + 1.1300\,\mu + 0.2250\,\pi = -0.2260$$
$$+64.2627 \quad +12.5807 \quad = +5.0979$$
$$+\ 5.8241 \quad = +1.0671$$

from which

$$c = -0.0285$$
$$\mu = +0.0758 = +0″.202 \qquad \mu_a = +0^s.056$$
$$\pi = +0.0206 = +0″.055 \pm 0″.011$$

Probable error corresponding to unit weight,

$$\pm 0.0077 = \pm 0″.020$$

Oxford 29°68304 (23^h21^m, +28°37′)

This is a faint star with a proper motion of 0″.588 per year, as derived from the Oxford plates. See *Monthly Notices of the Royal Astronomical Society*, Vol. LXXI (1911), p. 584. The photographic magnitude there given is 11.6, but visually it is at least a whole magnitude brighter. The plates were measured by Mr. Slocum.

TABLE 1

PLATES OF OXFORD 29°68304

No.	Date	Hour Angle	Observers	Quality of Images
484	1911 Sept. 2	−0h7	V	Fair
532	Oct. 14	−0.3	Su, V	Good[1]
569	Dec. 5	+0.3	Sl, V	Good[1]
583	Dec. 15	−0.2	V, Sl	Good[1]
834	1912 July 29	−1.4	Su, M	Fair[1]
840	Aug. 3	0.0	Su, Sl	Poor[1]
975	Nov. 2	−0.4	Su, Sl	Good
1016	Nov. 28	−0.3	Sl, Sl	Good
1030	Dec. 14	+0.1	M, Sl	Fair
1302	1913 July 6	−1.6	Su, M	Fair
1314	July 19	−0.8	Su, M	Poor
1322	July 24	−1.0	Su, M	Fair

[1] One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.12	−307	−156	+0.250
2	.13	−106	+277	.175
3	.13	− 45	− 82	.215
4	.18	+117	+158	.168
5	.14	+341	−197	+0.192
Parallax star	0.19	− 19.9	− 19.3	.....

The mean magnitude of the comparison stars is approximately 10.5.

TABLE 2

REDUCTIONS FOR OXFORD 29°68304

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
484	−0.232	0.5	+0.160	−359	−0.020	−0″.04
532	− .192	0.7	− .474	−317	+ .011	+ .02
569	− .185	0.7	− .900	−265	+ .001	+ .00
583	− .188	0.7	− .904	−255	− .007	− .01
834	− .024	0.5	+ .634	− 28	+ .019	+ .04
840	− .032	0.3	+ .574	− 23	+ .010	+ .01
975	− .027	1.0	− .706	+ 68	− .005	− .01
1016	− .006	1.0	− .884	+ 94	+ .007	+ .02
1030	− .008	0.7	− .904	+110	− .003	− .01
1302	+ .114	0.7	+ .847	+314	− .011	− .03
1314	+ .136	0.4	+ .742	+327	+ .006	+ .01
1322	+0.130	0.7	+0.692	+332	−0.001	0.00

The normal equations are:

$$\begin{aligned} 7.9\,c + 0.3570\,\mu - 1.8741\,\pi &= -0.3465 \\ +44.0884 \quad +6.3527 \quad &= +2.2272 \\ +4.5185 \quad &= +0.4679 \end{aligned}$$

from which

$$c = -0.0416$$
$$\mu = +0.0482 = +0''.128 \qquad \mu_a = +0^s.036$$
$$\pi = +0.0185 = +0''.049 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0.0061 = \pm 0''.016$$

35 γ Cephei (23^h35^m, $+77°4'$)

This star has been suggested as one of the standards for radial velocity observers. Its motion in the line of sight is given as −41 km per second. It is of type K, magnitude 3.4, and has a proper motion of 0".17. The rotating disk was used. Fifteen plates were measured by Mr. Mitchell.

TABLE 1

PLATES OF 35 γ CEPHEI

No.	Date	Hour Angle	Observers	Quality of Images
277	1910 July 30	−1h2	Su, Sl	Fair
346	Nov. 12	−0.1	Su, Sl	Good
355	Dec. 17	−0.1	Sl, Sl	Poor
453	1911 July 29	−0.7	V, Sl	Good
462	Aug. 5	−1.0	Sl	Good
537	Oct. 28	−1.0	Su, V	Good
587	Dec. 18	−0.4	Sl, V	Good
825	1912 July 21	−0.3	Su, M	Good
988	Nov. 10	−0.3	Su, Sl	Poor
1006	Nov. 17	−0.5	M, Sl	Good
1021	Dec. 8	−0.7	M, Sl	Good
1303	1913 July 6	−1.2	Su, M	Poor
1304	July 6	−0.9	Su, M	Fair
1311	July 12	−1.4	Su, M	Fair
1312	July 12	−0.8	Su, M	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.12	−367	+242	+0.139
2	.14	−185	− 8	.176
3	.27	− 69	−274	.219
4	.17	+ 57	− 69	.177
5	.12	+254	−114	.176
6	.12	+310	+223	+0.113
Parallax star	0.30	− 8.9	− 35.1	.....

The mean magnitude of the comparison stars is approximately 11.5.

TABLE 2

REDUCTIONS FOR 35 γ CEPHEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}.v$ in Arc
277	+0.048	0.7	+0.672	−633	0.000	0".00
346	− .004	1.0	− .757	−528	− .008	− .02
355	+ .002	0.4	− .903	−493	+ .004	+ .01
453	+ .032	1.0	+ .685	−269	+ .014	+ .04
462	+ .008	0.7	+ .607	−262	− .008	− .02
537	− .020	1.0	− .600	−178	+ .001	.00
587	− .026	1.0	− .903	−127	+ .007	+ .02
825	− .016	1.0	+ .757	+ 89	− .006	− .02
988	− .082	0.4	− .744	+201	− .026	− .04
1006	− .066	1.0	− .801	+208	− .008	− .02
1021	− .047	1.0	− .898	+229	+ .015	+ .04
1303	− .042	0.4	+ .870	+439	− .006	− .01
1304	− .028	0.7	+ .870	+439	+ .008	+ .02
1311	− .052	0.7	+ .832	+445	− .015	− .03
1312	−0.026	0.7	+0.832	+445	+0.011	+0.03

The normal equations are:

$$\begin{aligned} 11.7\,c - 2.1340\,\mu - 0.1587\,\pi &= -0.2308 \\ +143.3725 \quad +7.7966 \quad &= -0.9555 \\ +7.1620 \quad &= +0.1160 \end{aligned}$$

from which

$$c = -0.0209$$
$$\mu = -0.0083 = -0''.022 \qquad \mu_a = -0^s.024$$
$$\pi = +0.0248 = +0''.066 \pm 0''.007$$

Probable error corresponding to unit weight,

$$\pm 0.0069 = \pm 0''.018$$

SUMMARY OF RESULTS FOR 61 STARS (SLOCUM AND MITCHELL)

Star	R.A. 1900	Decl. 1900	B.D. Number	Magnitude and Spectrum	Proper Motion	Relative Parallax	Probable Error	No. of Plates	Probable Error of One Plate	No. of Comp. Stars
0Σ 547 A	0h 0m	+45° 16′	+45°4408	8.3, K2	0″.85	+0″.099	±0″.013	6	±0″.023	7
B	0 0	+45 16		8.3, K2	0.85	+ .084	.006	6	.011	7
C	0 0	+45 14		9.5	0.85	+ .112	.008	6	.014	7
30 ε Andromedae	0 33	+28 46	+28 103	4.5, G5	0.34	+ .042	.014	14	.037	3
37 μ Andromedae	0 51	+37 57	+37 175	3.9, A2	0.15	+ .005	.007	16	.017	4
Lalande 1966	1 3	+61 1	+60 170	7.1	0.64	− .011	.012	11	.027	5
†42 φ Andromedae	1 4	+46 43	+46 275	4.4, B8	0.03	+ .004	.008	8	.019	6
†48 Cassiopeiae	1 54	+70 25	+70 153	4.6, A2	0.06	+ .002	.016	10	.036	6
B.D. +48°739	2 36	+48 34	+48 739	9.1	0.38	+ .064	.009	10	.020	5
13 θ Persei	2 37	+48 48	+48 746	4.2, G	0.34	+ .083	.004	14	.010	3
Companion	2 37	+48 48		10	0.34	+ .071	.004	9	.010	3
†20 Persei	2 47	+37 56	+37 655	5.7, F	0.10	− .012	.007	13	.018	5
33 α Persei	3 17	+49 30	+49 917	2.2, F5	0.04	− .008	.011	14	.029	4
Lalande 6888	3 40	+41 9	+41 750	8.2	1.40	− .016	.011	16	.032	4
Lalande 6889	3 40	+41 9		8.8	1.40	+ .010	.008	16	.024	4
Comp. to Lal. 6888–9	3 40	+41 9		11	.....	− .012	.006	11	.013	4
46 ξ Persei	3 52	+35 30	+35 775	4.0, Oe5	0.02	− .010	.011	10	.024	5
A.Oe. 4961	4 30	+52 42	+52 857	8.5	0.48	+ .094	.007	13	.022	3
†9 Camelopardalis	4 44	+66 10	+66 358	4.4, B	0.01	− .032	.011	10	.018	5
37 φ¹ Orionis	5 29	+ 9 25	+ 9 877	4.7, B	0.01	− .005	.006	16	.017	4
Trapezium in Orion Nebula A	5 30	− 5 27		6.8, Oe5	0.00	− .014	.009	8	.019	6
Trapezium in Orion Nebula B	5 30	− 5 27		7.9, Oe5	0.01	− .026	.010	8	.021	6
Trapezium in Orion Nebula C	5 30	− 5 27	− 5 1315	5.4, Oe5	0.02	− .021	.010	8	.020	6
Trapezium in Orion Nebula D	5 30	− 5 27		6.9, Oe5	0.02	− .023	.007	8	.014	6
40 φ² Orionis	5 31	+ 9 14	+ 9 898	4.6, K	0.32	+ .010	.011	14	.029	6
†61 μ Orionis	5 57	+ 9 39	+ 9 1064	4.2, A2	0.03	+ .036	.016	8	.031	5
‡Nova Geminorum 2	6 48	+32 15		4 to 9, P	.....	+ .006	.007	15	.024	6
Weisse II, 8h596	8 29	+42 6	+42 1889	8.6	0.76	+ .018	.010	10	.018	6
Anonymous	11 6	+ 6 59		9.5	0.97	+ .010	.004	10	.008	6
Anonymous	12 17	+25 44		10.7	0.79	+ .043	.016	8	.023	4
B.D. +18°2696	13 5	+18 1	+18 2696	8.1	0.12	− .007	.002	4	.002	3
*42 Comae Berenices	13 5	+18 3	+18 2697	5.2, 5.2, F5	0.49	+ .058	.008	13	.015	6
*2 η Coronae Borealis	15 19	+30 39	+30 2653	5.6, 6.1, G	0.23	+ .073	.014	14	.031	4
Oxford +25°46692	16 0	+25 30	+25 3020	7.5	0.92	+ .063	.009	13	.020	5
†Groningen VII, No. 20	16 21	+48 35		10.7	1.22	+ .126	.012	10	.022	6
B.D. +42°2810	17 10	+42 28	+42 2810	9.4	1.11	+ .012	.009	12	.021	4
†Anonymous	17 34	+18 36		9.1	1.36	+ .108	.011	4	.019	6
†B.D. +18°3423	17 34	+18 37	+18 3423	9.0	0.24	+ .093	.004	9	.009	5
†B.D. +18°3424	17 34	+18 37	+18 3424	9.2	0.09	+ .003	.008	12	.018	4
†96 Herculis	17 58	+20 50	+20 3649	5.5, B	0.02	− .004	.008	12	.021	4
*70 Ophiuchi	18 0	+ 2 31	+ 2 3482	4.1, K	1.13	+ .212	.007	9	.015	6
4 ε¹ Lyrae pr	18 41	+39 34	+39 3509	5.0 A3	0.05	− .003	.005	15	.012	4
fol	18 41	+39 34		6.7 A3	0.06	− .007	.009	14	.024	4
5 ε² Lyrae pr	18 41	+39 30	+39 3510	4.9 A5	0.06	+ .006	.010	15	.026	4
fol	18 41	+39 30		5.2 A5	0.06	+ .012	.008	15	.022	4
B.D. +18°3911	18 56	+18 57	+18 3911	9.5	0.58	+ .009	.009	12	.023	5
†17 Lyrae C	19 04	+32 21		11.3	1.75	+ .124	.008	9	.014	5
16 Cygni pr	19 39	+50 18	+50 2847	6.2 F	0.22	+ .043	.008	15	.023	5
fol	19 39	+50 17		6.3 F	0.20	+ .028	.009	15	.027	5
†P Cygni	20 14	+37 43	+37 3871	4.9, B4P	0.01	− .021	.016	11	.023	5
3 η Cephei	20 43	+61 27	+61 2050	3.7, K	0.82	+ .066	.010	15	.027	6
Y Cygni	20 48	+34 17	+34 4184	7 to 8	.....	+ .001	.010	14	.019	6
61₁ Cygni	21 2	+38 15	+38 4343	5.6, K5	5.20	+ .277	.004	14	.011	6
61₂ Cygni	21 2	+38 15	+38 4344	6.3, K5	5.20	+ .277	.006	14	.017	6
†65 τ Cygni	21 10	+37 37	+37 4240	3.8, F	0.45	+ .006	.016	13	.031	4
23 ε Cephei	22 11	+56 33	+56 2749	4.7, A5	0.46	+ .060	.009	8	.019	5
†Nova Lacertae	22 32	+52 12		8 to 13, P	.....	+ .007	.012	13	.031	6
B.D. +28°4562	23 15	+28 19	+28 4562	8.5	0.75	+ .055	.011	14	.020	4
Oxford +29°68304	23 21	+28 39		11.6	0.59	+ .049	.009	12	.016	5
35 γ Cephei	23 35	+77 4	+76 928	3.4, K	0.17	+ .066	.007	15	.018	6
*85 Pegasi	23 56	+26 34	+26 4734	5.8, G	1.30	+0.084	±0.010	14	±0.020	4

* Details of observations and reduction in *Astrophysical Journal*, Vol. XLI (1915), p. 237.

† Details of observations and reduction in *Astrophysical Journal*, Vol. XXXVIII (1913), p. 1.

‡ Details of observations and reduction in *Monthly Notices*, Vol. LXXIII (1913), p. 437.

PARALLAXES OF SEVENTEEN STARS

PARALLAXES OF SEVENTEEN STARS

By Oliver J. Lee and Alfred H. Joy

The articles by F. Schlesinger in the *Astrophysical Journal*, Vols. XXXII (1910), XXXIII (1911), XXXIV (1911), and that by F. Slocum and S. A. Mitchell in Vol. XXXVIII (1913) of the same journal describe the apparatus and methods used in determining stellar parallaxes with the 40-inch refractor.

There has been no reason for changing the method of procedure described by these investigators, although some experimental work has been done in the matter of eliminating the magnitude error from parallax results by following out the scheme proposed by J. C. Kapteyn in the *Astrophysical Journal*, Vol. XLI (1915), p. 77. Mr. Frank R. Sullivan assisted most efficiently in securing the plates. The significance of the abbreviations in the column headed "Observers" is: F = P. Fox, J = Joy, L = Lee, M = Mitchell, Sl = Slocum, Su = F. R. Sullivan, V = A. van Maanen.

Miss Eudora Magill, of the observatory staff, did much of the computing.

All values given in the tables and in the reductions are in terms of scale-divisions, unless otherwise stated. One division of the scale is $\frac{1}{4}$ mm and equals 2″.66. In all cases the displacement was measured parallel to the equator. The solution yields the proper motion for 100 days. It is also given in seconds of time for the year.

26 β Persei (Algol) (3^h2^m, +40°34′)

The unusual interest of Algol from the photometric and spectroscopic points of view is sufficient reason for this additional determination of its parallax. The thirteen plates were secured as described in Table 1. They were measured by Mr. Lee.

TABLE 1

Plates of 26 β Persei

No.	Date	Hour Angle	Observers	Quality of Images
503	1911 Sept. 16	-1^h3	Su, V	Good
888	1912 Sept. 7	+0.1	Su, M	Fair
896	Sept. 8	−1.3	Su, M	Fair
1054	Dec. 28	−0.2	Su, Sl	Fair
1062	1913 Jan. 11	0.0	Su, Sl	Fair
1099	Feb. 2	−0.2	M, Sl	Good
1122	Feb. 9	+0.1	Sl	Fair
1368	Sept. 13	0.0	Su, Sl	Good
1380	Sept. 14	0.0	Su, Sl	Poor
1479	1914 Jan. 17	+0.2	Sl	Good
1696	Oct. 1	−0.2	Su, L	Fair
1868	Dec. 16	−0.1	Su, L	Fair*
1892	1915 Jan. 2	−0.4	Su, L	Good

* One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.19	−206	− 18	+0.202
2	0.29	− 62	+156	0.428
3	0.33	+268	−138	+0.370
Parallax star	0.44	+ 31.0	+ 12.1	.....

The mean magnitude of the comparison stars is 8.9. The sector was used for the parallax star.

TABLE 2

Reductions for 26 β Persei

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
503	−0.014	1.0	+0.789	−654	−0.021	−0″.05
888	− .009	0.7	+ .860	−297	− .004	− .01
896	+ .008	0.7	+ .852	−296	+ .013	+ .03
1054	− .024	0.7	− .712	−185	− .004	− .01
1062	− .045	0.7	− .843	−171	− .024	− .05
1099	− .013	1.0	− .944	−149	+ .010	+ .03
1122	− .013	0.7	− .947	−142	+ .010	+ .02
1368	− .001	1.0	+ .811	+ 74	+ .016	+ .04
1380	+ .021	0.4	+ .802	+ 75	+ .038	+ .06
1479	− .010	1.0	− .882	+200	+ .024	+ .06
1696	− .050	0.7	+ .615	+457	− .019	− .04
1868	− .087	0.5	− .559	+533	− .044	− .08
1892	−0.048	1.0	−0.759	+550	−0.004	−0.01

The normal equations are:

$$10.1\,c - 1.263\,\mu - 1.066\,\pi = -0.214$$
$$127.000 - 9.054 = -0.459$$
$$6.710 = +0.102$$

from which

$$c = -0.021$$
$$\mu = -0.0033 = -0''.009 = -0^s.003 \text{ per year}$$
$$\pi = +0.0074 = +0''.020 \pm 0''.014$$

Probable error corresponding to unit weight,

$$\pm 0.0131 = \pm 0''.035$$

The following parallaxes of Algol by other observers are added:

Chase, $+0''.037 \pm 0''.025$
Flint, $+0.122 \pm 0.026$
Russell, $+0.007 \pm 0.027$

14 θ Canis Majoris (6^h49^m, $-11°55'$)

This fourth-magnitude star, of type K 5, has a large radial velocity of +96 km according to W. W. Campbell (*Astrophysical Journal*, Vol. XIII [1901], p. 98). Boss gives a proper motion of $-0^s.009$ and $-0''.015$ per year. Eleven plates were secured as described in Table 1. They were measured by Mr. Joy.

TABLE 1

PLATES OF 14 θ CANIS MAJORIS

No.	Date	Hour Angle	Observers	Quality of Images
131	1909 Oct. 16	-0^h2	Su, Sl	Fair
141	Oct. 30	−0.1	Su, Sl	Fair
220	1910 Feb. 27	+0.2	Su, Sl	Good
334	Oct. 22	−2.0	Su, Sl	Fair
383	1911 Mar. 4	+0.6	Sl, Su	Fair
526	Oct. 7	−1.1	Su, Sl	Good
1828	1914 Nov. 21	−0.3	Su, J	Good
1980	1915 Mar. 7	0.0	Su, J	Good
2011	Mar. 13	+0.2	Su, L	Good
2024	Mar. 27	+0.5	L	Good
2025	Mar. 27	+0.8	L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.35	+291	+152	+0.203
2	.13	+138	−232	.211
3	.27	−213	−359	.206
4	.16	+ 4	+254	.192
5	.22	−220	+185	+0.188
Parallax star	0.27	+ 3.8	− 8.4	.....

The mean magnitude of the comparison stars is approximately 9.8. The rotating disk was used to cut down the light of the parallax star.

TABLE 2

REDUCTIONS FOR 14 θ CANIS MAJORIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\,v$ in Arc
131	+0.120	0.7	+0.971	−1048	+0.014	+0''.03
141	+ .096	0.7	+ .890	−1034	− .007	− .02
220	+ .080	0.8	− .829	− 914	+ .002	+ .01
334	+ .052	1.0	+ .945	− 677	+ .002	.00
383	+ .022	0.7	− .872	− 544	− .000	.00
526	− .020	0.7	+ .994	− 327	− .018	− .04
1828	− .166	1.0	+ .662	+ 814	+ .007	+ .02
1980	− .200	1.0	− .896	+ 920	− .004	− .01
2011	− .182	0.7	− .936	+ 926	+ .015	+ .03
2024	− .204	1.0	− .990	+ 940	− .005	− .01
2025	−0.202	1.0	−0.990	+ 940	−0.003	−0.01

The normal equations are:

$$+9.3\,c + 7.869\mu - 1.199\pi = -0.631$$
$$680.230 - 40.389 = -10.737$$
$$7.696 = +0.701$$

from which

$c = -0.055$
$\mu = -0.0543 = -0''.143 = -0^s.036$ per year
$\pi = +0.0044 = +0''.012 \pm 0''.007$

Probable error corresponding to unit weight,

$$\pm 0.0062 = \pm 0''.016$$

Lalande 15565 (7^h54^m, $+29°31'$)

For this star of magnitude 7.5 and type G Porter gives a proper motion of $-0^s.011$ and $-1''.18$ (*Astronomical Journal*, Vol. XII [1893], p. 27). Ten plates were secured as described in Table 1. They were measured by Mr. Joy.

TABLE 1

PLATES OF LALANDE 15565

No.	Date	Hour Angle	Observers	Quality of Images
142	1909 Oct. 30	-0^h3	Su, Sl	Fair
384	1911 Mar. 4	0.0	Su, Sl	Fair
684	1912 Mar. 5	−0.2	Su, V	Fair
1752	1914 Oct. 24	0.0	Su, L	Fair
1854	Nov. 26	−0.3	Su, L	Good
1858	Dec. 2	−0.5	Su, J	Fair
1946	1915 Feb. 18	−0.2	Su, J	Good
1959	Feb. 27	−0.2	L	Good
1967	Feb. 28	+0.1	Su, J	Good
1999	Mar. 11	0.0	Su, J	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.26	−118	+177	+0.260
2	.18	−335	−199	.221
3	.13	− 30	−100	.184
4	.14	+256	−108	.129
5	.18	+227	+230	+0.206
Parallax star	0.31	− 30.1	+ 17.2	.....

The mean magnitude of the comparison stars is approximately 10.2. The rotating disk was used to cut down the light of the parallax star.

TABLE 2

REDUCTIONS FOR LALANDE 15565

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\,v$ in Arc
142	+0.646	0.5	+0.957	−1467	−0.018	−0''.04
384	.556	0.7	− .709	− 977	+ .008	+ .02
684	.498	0.7	− .729	− 610	+ .012	+ .03
1752	.352	0.9	+ .973	+ 353	− .008	− .02
1854	.358	1.0	+ .767	+ 386	+ .007	+ .02
1858	.382	0.3	+ .700	+ 392	+ .034	+ .05
1946	.326	1.0	− .525	+ 470	+ .016	+ .04
1959	.295	0.4	− .648	+ 479	− .011	− .02
1967	.292	1.0	− .660	+ 480	− .013	− .04
1999	+0.286	0.9	−0.787	+ 491	−0.015	−0.04

The normal equations are:

$$+7.4\,c+\ 5.604\mu-0.828\pi=+2.844$$
$$307.198\ -2.538\ =-2.955$$
$$4.206\ =-0.201$$

from which

$$c=+0.399$$
$$\mu=-0.0611=-0''.162=-0^{s}.045 \text{ per year}$$
$$\pi=+0.0207=+0''.055\pm0''.013$$

Probable error corresponding to unit weight,

$$\pm.0097=\pm0''.026$$

Other determinations of this parallax are:

Flint (transit circle), $+0.070\pm0''.026$
Jost (transit circle), $+0.110\pm0.032$
Chase (heliometer), $+0.031\pm0.042$

D'Agelet 1623 (8^h49^m, $+26°35'$)

This seventh-magnitude star, B.D. $+26°1865$, has a proper motion of $+0^{s}.004$ and $-0''.43$ according to F. Ristenpart in *Astronomische Nachrichten*, Vol. CLXXVII (1908), p. 337. The twelve plates described in Table 1 were measured by Mr. Lee.

TABLE 1

PLATES OF D'AGELET 1623

No.	Date	Hour Angle	Observers	Quality of Images
598.....	1911 Dec. 18	$-0^h.8$	Su, Sl	Fair
670.....	1912 Feb. 18	−0.2	Su, V	Fair
686.....	Mar. 5	−0.1	V, Sl	Good
981.....	Nov. 7	0.0	Su, Sl	Good
1027.....	Dec. 8	−0.2	Su, M	Good
1172.....	1913 Mar. 16	−0.8	Su, Sl	Good
1177.....	Mar. 29	+0.3	Su, M	Good
1453.....	Dec. 13	−0.3	Su, Sl	Poor
1545.....	1914 Apr. 2	−0.4	Su, Sl	Good
1547.....	Apr. 4	−0.1	Su, Sl	Good
1805.....	Nov. 5	+0.1	Su, L	Fair
1855.....	Nov. 26	−0.7	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.31	−427	−187	+0.262
2.....	.60	+199	+300	.378
3.....	.38	+228	−113	+0.360
Parallax star...	0.25	+ 45.4	+ 23.7	.....

The mean magnitude of the comparison stars is 8.8. The sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR D'AGELET 1623

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
598....	−0.098	0.7	+0.654	−536	+0.006	+0''.01
670....	.112	0.7	− .313	−474	− .009	− .02
686....	.090	1.0	− .552	−458	+ .012	+ .03
981....	.064	1.0	+ .949	−211	+ .008	+ .02
1027....	.068	1.0	+ .758	−180	+ .002	.00
1172....	.092	0.7	− .689	− 82	− .026	− .06
1177....	.080	1.0	− .823	− 69	− .014	− .04
1453....	.057	0.4	+ .706	+190	− .023	− .04
1545....	.030	1.0	− .854	+300	.000	.00
1547....	.005	1.0	− .870	+302	+ .025	+ .07
1805....	.004	0.7	+ .953	+517	− .003	− .01
1855....	−0.000	1.0	+0.866	+538	−0.001	0.00

The normal equations are:

$$10.2\,c-\ 1.045\mu+0.180\pi=-0.574$$
$$132.672\ +2.165\ =+1.354$$
$$6.229\ =+0.038$$

from which

$$c=-0.055$$
$$\mu=+0.0097=+0''.026=+0^{s}.007 \text{ per year}$$
$$\pi=+0.0044=+0''.012\pm0''.010$$

Probable error corresponding to unit weight,

$$\pm0.0095=\pm0''.025$$

Argelander-Oeltzen 10640 (10^h7^m, $+53°1'$)

This is a ninth-magnitude star for which Ristenpart, in *Astronomische Nachrichten*, Vol. CLXXVII (1908), p. 337, gives a proper motion of $0''.70$ per year in declination. Thirteen plates were secured as described in Table 1. They were measured by Mr. Joy.

TABLE 1

PLATES OF A.OE. 10640

No.	Date	Hour Angle	Observers	Quality of Images
404.....	1911 Apr. 22	$-0^h.1$	Sl	Poor
556.....	Nov. 24	−0.5	Su, V	Good
601.....	Dec. 18	−0.6	Su, V	Good
646.....	1912 Jan. 20	−0.8	Su, V	Poor
688.....	Mar. 5	−0.1	Sl, Su	Good
741.....	Apr. 14	0.0	V, Su	Fair
1040.....	Dec. 21	−1.0	Su, Sl	Good
1041.....	Dec. 21	−0.4	Su, Sl	Fair
1049.....	Dec. 22	−0.8	Su, Sl	Poor
1194.....	1913 Apr. 13	−0.2	Su, Sl	Good
1549.....	1914 Apr. 4	−0.4	Su, Sl	Good
2015.....	1915 Mar. 13	−0.8	Su, L	Good
2028.....	Mar. 27	0.0	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.21	−284	+288	+0.147
2.....	.19	−244	−211	.351
3.....	.17	+134	− 41	.184
4.....	.19	+ 89	+ 96	.137
5.....	.17	+305	−132	+0.181
Parallax star...	0.39	− 35.3	− 50.1	.....

The mean magnitude of the comparison stars is about 10.6.

TABLE 2

REDUCTIONS FOR A.OE. 10640

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
404....	+0.121	0.5	−0.830	−607	+0.018	+0″.03
556....	.180	1.0	+ .923	−391	+ .010	+ .03
601....	.174	1.0	+ .825	−367	+ .004	+ .01
646 ...	.144	0.7	+ .461	−334	− .020	− .05
688....	.156	1.0	− .245	−289	+ .005	+ .01
741....	.128	1.0	− .768	−249	− .013	− .04
1040....	.220	1.0	+ .796	+ 2	+ .013	+ .03
1041....	.198	0.7	+ .795	+ 2	− .009	− .02
1049 ...	.187	0.6	+ .787	+ 3	− .020	− .04
1194....	.176	1.0	− .756	+115	− .002	− .01
1549....	.224	1.0	− .657	+471	+ .007	+ .02
2015....	.264	0.7	− .357	+814	+ .004	+ .01
2028....	+0.254	1.0	−0.555	+828	−0.002	−0.01

The normal equations are:

$$11.2\,c + 1.557\,\mu + 0.249\,\pi = +2.109$$
$$207.988 \quad -13.127 \quad = +2.059$$
$$5.524 \quad = +0.056$$

from which

$$c = +0.186$$
$$\mu = +0.0369 = +0''.099 = +0^{s}.039 \text{ per year}$$
$$\pi = +0.0258 = \mathbf{+0''.069 \pm 0''.009}$$

Probable error corresponding to unit weight,

$$\pm 0.0076 = \pm 0''.020$$

Lalande 23223 (12^h20^m, $-3°44'$)

This is an eighth-magnitude star for which Porter gives proper motions of $-0^{s}.0098$ and $-0''.202$. See *Publications of the Cincinnati Observatory* (1898), No. 14. Ten plates of this star were secured as described in Table 1. They were measured by Mr. Lee.

TABLE 1

PLATES OF LALANDE 23223

No.	Date	Hour Angle	Observers	Quality of Images
673.....	1912 Feb. 18	−0^h.3	Su, Sl	Poor
764.....	May 18	+0.6	Su, Sl	Good
1064.....	1913 Jan. 11	−0.2	Su, Sl	Poor
1079.....	Jan. 23	0.0	Su, Sl	Fair
1106.....	Feb. 6	−1.1	Su, M	Good
1210.....	May 10	+0.6	Su, M	Poor
1216.....	May 11	−0.1	Su, Sl	Poor
1474.....	Dec. 21	0.0	Su, Sl	Good
1570.....	Apr. 25	−0.3	Su, L	Poor
1583.....	May 16	+0.4	Su, L	Poor

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.14	−171	−132	+0.223
2.....	.26	−163	− 73	.243
3.....	.22	− 23	+274	.323
4.....	.13	+116	− 80	.115
5.....	.13	+241	+ 11	+0.096
Parallax star...	0.45	− 48.8	+ 33.4	.....

The mean magnitude of the comparison stars is 10.7.

TABLE 2

REDUCTIONS FOR LALANDE 23223

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
673....	+0.043	0.4	+0.537	−429	+0.016	+0″.03
764....	− .015	1.0	− .734	−339	− .007	− .02
1064....	+ .002	0.4	+ .868	−101	+ .007	+ .01
1079....	− .018	0.7	+ .796	− 89	− .010	− .02
1106....	− .018	1.0	+ .669	− 75	− .006	− .02
1210....	− .018	0.4	− .647	+ 18	+ .030	+ .05
1216....	− .048	0.4	− .658	+ 19	.000	.00
1474....	− .042	1.0	+ .899	+243	+ .003	+ .01
1570....	− .082	0.4	− .455	+368	+ .004	+ .01
1583....	−0.107	0.4	−0.709	+389	−0.014	−0.02

The normal equations are:

$$6.1\,c - 1.277\,\mu + 0.966\,\pi = -0.172$$
$$37.781 \quad +0.534 \quad = -0.393$$
$$3.279 \quad = +0.024$$

from which

$$c = -0.034$$
$$\mu = -0.0118 = -0''.031 = -0^{s}.008 \text{ per year}$$
$$\pi = +0.0191 = \mathbf{+0''.051 \pm 0''.010}$$

Probable error corresponding to unit weight,

$$\pm 0.0069 = \pm 0''.018$$

Berlin B 5072–73 (14^h21^m, $+24°6'$)

A discordance was noted by F. A. Bellamy between the measures of the Oxford plate and the *Berlin B Catalogue*. A comparison of two astro-

graphic plates taken in 1893 and in 1899 gave proper motions of $+0^{s}.070$ and $-1''.26$. See *Monthly Notices*, Vol. LX (1899), p. 125. From micrometric measures (1903 to 1906) Burnham gets $1''.38$ per year, and from meridian positions of Berlin and of Cincinnati Porter likewise gets $1''.38$ per year.

Fourteen plates have been secured as described in Table 1. They have been measured by Mr. Lee.

TABLE 1

PLATES OF BERLIN B 5072–73

No.	Date	Hour Angle	Observers	Quality of Images
667.....	1912 Feb. 9	$-0^{h}.2$	Sl, V	Poor
676.....	Feb. 18	−0.7	V, Sl	Fair
696.....	Mar. 17	−1.1	Sl, V	Good
775.....	June 8	+0.4	Sl, M	Good
1119.....	1913 Feb. 8	−0.2	Su, Sl	Fair
1250.....	June 8	−0.3	Su, Sl	Poor
1256.....	June 12	+0.1	Su, Sl	Fair
1261.....	June 21	+0.3	Su, M	Poor
1267.....	June 22	+0.5	Sl, Su	Poor
1484.....	1914 Jan. 31	−0.2	Su, Sl	Poor
1501.....	Feb. 15	−0.3	Su, Sl	Fair
1506.....	Feb. 26	−0.1	Su, Sl	Good
1519.....	Mar. 8	−0.1	Su, Sl	Good
1594.....	May 30	−0.4	Su, Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence	
				5072	5073
	mm				
1.....	0.16	−292	−160	+0.087	+0.073
2.....	.14	−184	−211	.179	.160
3.....	.27	− 65	+ 27	.151	.147
4.....	.29	+ 91	− 51	.192	.196
5.....	.16	+174	−107	.216	.225
6.....	.20	+276	+182	+0.175	+0.199
5072.....	.28	+ 35.3	− 20.6	.....	.....
5073.....	0.26	+ 51.7	− 16.0	.....	.....

The mean magnitude of the comparison stars is approximately 10.7.

TABLE 2

REDUCTIONS FOR BERLIN B 5072–73

Plate	Solution (m)		Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p \cdot v}$ in Arc	
	5072	5073				5072	5073
667..	−0.008	−0.054	0.4	+0.911	−451	+0″.01	+0″.01
676..	− .008	− .048	0.7	+ .869	−442	.00	+ .01
696..	+ .006	− .048	1.0	+ .610	−414	− .01	− .03
775..	+ .053	+ .007	1.0	− .619	−331	+ .02	+ .02
1119..	+ .262	+ .242	0.7	+ .912	− 86	− .05	.00
1250..	+ .366	+ .291	0.4	− .616	+ 34	+ .04	− .02
1256..	+ .336	+ .284	0.7	− .664	+ 38	− .02	− .04
1261..	+ .324	+ .316	0.4	− .761	+ 47	− .04	+ .01
1267..	+ .372	+ .337	0.4	− .770	+ 48	+ .03	+ .05
1484..	+ .580	+ .529	0.4	+ .930	+271	.00	− .01
1501..	+ .610	+ .564	0.7	+ .883	+286	+ .04	+ .04
1506..	+ .595	+ .552	1.0	+ .810	+297	− .01	.00
1519..	+ .610	+ .552	1.0	+ .717	+307	+ .02	− .02
1594..	+0.630	+0.598	1.0	−0.495	+390	−0.03	0.00

The normal equations are:

	5072	5073
$9.8\,c+\ 0.858\mu+2.301\pi$	$=+3.388,$	$=+2.958$
$92.872\ -0.457$	$=+7.900,$	$=+7.884$
5.434	$=+0.871,$	$=+0.761$

from which

5072	5073
$c=+0.332$	$=+0.289$
$\mu=+0.0821=+0''.218$	$=+0.082\ =+0''.219$
$\mu_a=+0^{s}.058$	$\mu_a=+0^{s}.058$
$\pi=+0.0265=$	$=+0.0246=$
$+0''.070\pm0''.010$	$+0''.065\pm0''.008$

Probable error corresponding to unit weight,

$\pm0.0082=\pm0''.022$ $\pm0.0068=\pm0''.018$

Russell has obtained the following parallaxes:

for Berlin B 5072, $\pi=+0.059\pm0''.036$
for Berlin B 5073, $\pi=-0.012\pm0.027$

Lalande 27744 ($15^{h}9^{m}$, $-1°0'$)

This seventh-magnitude star, B.D. $-0°2944$, of type G 7, has a proper motion of $1''.45$ per year. See *Proceedings of Royal Society of Edinburgh*, Vol. XXIX (1909), p. 379. The fourteen plates described in Table 1 were measured by Mr. Lee.

TABLE 1

PLATES OF LALANDE 27744

No.	Date	Hour Angle	Observers	Quality of Images
213.....	1910 Feb. 12	$+0^{h}.1$	Sl	Poor
261.....	June 25	−0.1	Su, Sl	Good
422.....	1911 June 10	−0.3	Su, Sl	Good
1140.....	1912 Dec. 21	−1.0	Su, Sl	Fair
1142.....	Dec. 21	−0.6	Su, Sl	Good
1173.....	1913 Jan. 23	−0.1	M, Su	Good
1285.....	June 29	+0.4	Su, M	Fair
1300.....	July 6	+1.0	Su, M	Good
1305.....	July 10	+0.7	Su, M	Fair
1503.....	1914 Feb. 15	+0.4	Su, Sl	Poor
1520.....	Mar. 8	−0.1	Su, Sl	Fair
1525.....	Mar. 12	−0.1	Su, Sl	Good
1602.....	June 18	+0.5	Su, Sl	Good
1613.....	July 5	+0.4	Su, L	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.33	−394	− 33	+0.184
2.....	.33	−298	−101	.188
3.....	.34	−221	+241	.151
6.....	.22	+230	−277	.186
7.....	.23	+313	− 32	.158
8.....	.48	+370	+202	+0.133
Parallax star...	0.28	− 20.3	− 18.5	.....

The mean magnitude of the comparison stars is 9.4. The rotating sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR LALANDE 27744

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
213....	+0.395	0.4	+0.949	−1092	+0.016	+0".03
261....	+0.171	1.0	− .677	− 959	− .002	.00
422....	−0.280	1.0	− .478	− 609	− .004	− .01
1140....	−1.044	0.7	+ .948	+ 4	− .004	− .01
1142....	−1.062	1.0	+ .942	+ 8	− .017	− .05
1173....	−1.072	1.0	+ .772	+ 36	+ .013	+ .03
1285....	−1.272	0.7	− .726	+ 141	− .020	− .04
1300....	−1.252	1.0	− .708	+ 148	+ .011	+ .03
1305....	−1.264	0.7	− .833	+ 152	+ .005	+ .01
1503....	−1.504	0.4	+ .944	+ 372	+ .012	+ .02
1520....	−1.540	0.7	+ .843	+ 393	+ .005	+ .01
1525....	−1.556	1.0	+ .811	+ 397	− .005	− .01
1602....	−1.701	1.0	− .591	+ 495	+ .007	+ .02
1613....	−1.740	0.7	−0.786	+ 512	−0.006	−0.01

The normal equations are:

$$11.3\,c + 0.694\mu + 0.350\pi = -12.000$$
$$257.052 + 4.055 = -33.921$$
$$6.944 = -0.746$$

from which

$$c = -1.054$$
$$\mu = -0.1295 = -0''.344 = -0^{s}.084 \text{ per year}$$
$$\pi = +0.0214 = +0''.057 \pm 0''.007$$

Probable error corresponding to unit weight,

$$\pm 0.0069 = \pm 0''.018$$

Two parallax determinations of this star have been published:

Flint, $+0''.11 \pm 0''.031$
Smith, $+0.072 \pm 0.014$

10 λ Ophiuchi ($16^{h}26^{m}$, $+2°12'$)

This bright double star of type A has a proper motion of 0".10 according to Boss. The position angle has changed about 90° since Struve first observed it in 1825. The present distance is about 1".2. Burnham says of this star, "Nothing whatever is known concerning the orbit, and probably this uncertainty will continue for the better part of another century." The two star-images blend on our plates. The parallax is derived from thirteen plates described in Table 1. They were measured by Mr. Lee.

TABLE 1

PLATES OF 10 λ OPHIUCHI

No.	Date	Hour Angle	Observers	Quality of Images
89.....	1909 Mar. 20	+0^{h}3	F, Su	Fair
1301.....	1913 July 6	+0.5	Su, M	Fair
1307.....	July 10	+0.7	M, Su	Good
1309.....	July 12	+0.1	Su, M	Good
1313.....	July 19	+0.2	Su, M	Poor
1537.....	1914 Mar. 19	−1.0	Su, Sl	Good
1538.....	Mar. 19	−0.5	Su, Sl	Fair
1542.....	Mar. 22	−1.0	Su, Sl	Good
1618.....	July 11	−0.5	Su, L	Good
1623.....	July 15	0.0	Su, L	Good
1629.....	July 18	+0.4	Su, L	Fair
1944.....	1915 Feb. 17	−0.6	Su, L	Poor
1962.....	Feb. 27	−0.2	Su, J	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−246	− 12	+0.267
2.....	0.19	− 11	+283	.270
3.....	0.17	+ 43	−280	.228
4.....	0.10	+214	+ 9	+0.235
Parallax star...	0.34	− 8.7	+ 11.5	.....

The mean magnitude of the comparison stars is 10.3. The sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR 10 λ OPHIUCHI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
89....	−0.108	0.7	+0.913	−1687	−0.002	0".00
1301....	.150	0.7	− .591	− 118	− .006	− .01
1307....	.142	1.0	− .643	− 114	+ .003	+ .01
1309....	.138	1.0	− .668	− 112	+ .007	+ .02
1313....	.150	0.4	− .750	− 105	− .004	− .01
1537....	.137	1.0	+ .921	+ 138	+ .002	+ .01
1538....	.132	0.7	+ .921	+ 138	+ .007	+ .02
1542....	.144	1.0	+ .902	+ 141	− .005	− .01
1618....	.157	1.0	− .652	+ 252	− .006	− .01
1623....	.152	1.0	− .702	+ 256	.000	.00
1629....	.151	0.7	− .736	+ 259	+ .001	.00
1944....	.144	0.4	+ .962	+ 473	.000	.00
1962....	−0.146	0.7	+0.078	+ 483	−0.001	0.00

The normal equations are:

$$10.3\,c + 0.607\mu + 0.282\pi = -1.468$$
$$251.292 - 4.713 = -0.566$$
$$6.505 = +0.012$$

from which

$$c = -0.143$$
$$\mu = -0.0018 = -0''.005 = -0^{s}.001 \text{ per year}$$
$$\pi = +0.0067 = +0''.018 \pm 0''.003$$

Probable error corresponding to unit weight,

$$\pm 0.0029 = \pm 0''.008$$

U Ophiuchi (17^h14^m, $+1°18'$)

This is a variable star of the Algol type. Its period is 20^h8^m. Its spectrum is B 8. The hypothetical parallax of 0".006, as given by Shapley in *Contributions from the Princeton University Observatory*, No. 3, indicates that this is one of the nearer stars of this type. Twelve plates of this star were secured as described in Table 1. They were measured by Mr. Joy.

TABLE 1

PLATES OF U OPHIUCHI

No.	Date	Hour Angle	Observers	Quality of Images
229	1910 Mar. 19	-1^h7	Su, Sl	Fair
263	June 25	−0.7	Su, Sl	Good
416	1911 May 6	−1.2	Su, Sl	Good
440	July 8	−0.3	Sl, Su	Good
456	Aug. 5	+0.3	Su, Sl	Good
737	1912 Apr. 9	−0.4	V, Sl	Good
756	Apr. 23	−0.4	Su, Sl	Fair
815	July 13	+0.2	Su	Good
1334	1913 Aug. 2	+0.8	Su, M	Good
1544	1914 Mar. 22	+0.1	Su, Sl	Fair
1571	Apr. 25	−0.5	Su, L	Fair
1624	July 15	+0.1	Su, L	Poor

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.19	−197	+169	+0.201
2	.13	−171	+ 62	.193
3	.15	−201	−209	.187
4	.17	+ 65	−169	.151
5	.12	+222	− 82	.132
6	.11	+282	+230	+0.135
Parallax star	0.21	− 32.7	+ 1.4	.....

The mean magnitude of the comparison stars is approximately 10.8. The rotating disk was used to cut down the light of the parallax star.

TABLE 2

REDUCTIONS FOR U OPHIUCHI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
229	+0.023	0.7	+0.977	−750	−0.010	−0".02
263	− .006	1.0	− .259	−652	− .001	.00
416	+ .006	0.8	+ .551	−337	− .004	− .01
440	+ .023	1.0	+ .460	−274	− .001	.00
456	− .028	0.8	− .814	−246	+ .006	+ .01
737	− .032	1.0	+ .854	+ 2	+ .001	.00
756	− .023	0.8	+ .709	+ 16	+ .001	.00
815	.000	0.5	− .544	+ 97	+ .004	+ .01
1334	+ .024	1.0	− .789	+482	+ .004	+ .01
1544	+ .007	0.7	+ .967	+714	+ .001	.00
1571	+ .017	0.8	+ .692	+748	+ .001	.00
1624	+0.001	0.6	−0.565	+829	+0.008	+0.02

The normal equations are:

$$+9.699\,c + 2.238\,\mu + 1.006\,\pi = +0.007$$
$$248.766 + .132 = +0.151$$
$$4.851 = -0.018$$

from which

$$c = +0.001$$
$$\mu = +0.0022 = +0''.006 = +0''.001 \text{ per year}$$
$$\pi = -0.0040 = -0''.011 \pm 0''.004$$

Probable error corresponding to unit weight,

$$\pm 0.0030 = \pm 0''.008$$

Draconis 205 (18^h45^m, $+49°19'$)

This seventh-magnitude star is β 971. It is a binary of rapid period whose orbit is nearly in the plane of the line of sight. The components were too close to be separated in the period covered by these plates. The proper motion is small. Thirteen plates of this star were secured as described in Table 1. They were measured by Mr. Joy.

TABLE 1

PLATES OF DRACONIS 205

No.	Date	Hour Angle	Observers	Quality of Images
758	1912 Apr. 23	-0^h9	Su, Sl	Good
768	May 18	−1.5	Su, Sl	Good
901	Sept. 15	−0.1	M, Sl	Fair
1200	1913 Apr. 19	−1.2	Su, Sl	Fair
1207	Apr. 27	−1.2	Su, M	Fair
1342	Aug. 17	0.0	Su	Good
1354	Sept. 6	0.0	Su, Sl	Good
1361	1914 Apr. 11	−0.9	Su, Sl	Good
1366	Apr. 16	−0.6	Su, L	Poor
1660	Aug. 20	−0.1	Su, L	Fair
1670	Aug. 29	−0.6	Su	Good
1671	Sept. 3	0.0	Su, L	Good
1675	Sept. 12	0.0	L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.14	−164	−309	+0.175
2	.22	+195	−249	.209
3	.14	+299	+113	.230
4	.22	+ 19	+305	.212
5	.33	−349	+140	+0.174
Parallax star	0.18	+ 23.9	+ 8.8	.....

The mean magnitude of the comparison stars is about 10.0. The rotating disk was used to cut down the brightness of the parallax star.

TABLE 2

REDUCTIONS FOR DRACONIS 205

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ In Arc
758....	−0.221	1.0	+0.920	−484	+0.011	+0".03
768....	.218	1.0	+ .680	−459	+ .007	+ .02
901....	.205	0.7	− .955	−339	− .014	− .03
1200....	.188	0.9	+ .945	−123	− .024	− .06
1207....	.208	0.8	+ .894	−115	− .004	− .01
1342....	.230	0.5	− .704	− 3	+ .010	+ .02
1354....	.212	0.9	− .899	+ 17	− .009	− .02
1361....	.232	0.6	+ .980	+234	+ .018	+ .04
1366....	.203	0.4	+ .961	+239	− .011	− .02
1660 ...	222	0.9	− .736	+365	.000	.00
1670....	.220	0.5	− .830	+374	− .001	.00
1671....	.230	0.9	− .874	+379	+ .007	+ .02
1675....	−0.222	0.9	−0.937	+388	− .001	0.00

The normal equations are:

$$+10.0\,c + 0.743\,\mu - 0.403\,\pi = -2.171$$
$$106.040 \quad -15.250 \quad = -0.301$$
$$7.624 \quad = +0.131$$

from which

$$c = -0.217$$
$$\mu = -0.0007 = -0".002 = -0".001 \text{ per year}$$
$$\pi = +0.0044 = +0".012 \pm 0".008$$

Probable error corresponding to unit weight,

$$\pm 0.0075 = \pm 0".020$$

β G.C. 9919 (20^h2^m, +35°30′)

This pair of stars was measured by Sir William Herschel in 1783 and was given his number, 113. Measures by South and Sir John Herschel in 1823 and modern measures show very little change. The parallaxes agree well within the probable errors. Similarly, the proper motions are concordant, although our plates cover only a year of time. The plates were measured by Mr. Lee.

TABLE 1

PLATES OF β G.C. 9919

No.	Date	Hour Angle	Observers	Quality of Images
925.....	1912 Sept. 29	−0^{h}4	M, Sl	Good
942.....	Oct. 13	0.4	Sl, M	Good
948.....	Oct. 19	0.2	Sl, M	Fair
1231.....	1913 May 31	0.8	Su, Sl	Good
1238.....	June 1	0.9	Su, M	Good
1246.....	June 7	0.5	Su, Sl	Good
1247.....	June 7	0.2	Su, Sl	Good
1252.....	June 8	0.5	Su, M	Good
1362.....	Sept. 13	0.3	Su, Sl	Good
1374.....	Sept. 14	0.5	Su, Sl	Good
1390.....	Oct. 5	0.5	Sl	Good
1395.....	Oct. 11	−0.5	Sl	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence	
				A	D
	mm				
1.....	0.29	−199	−109	+0.151	+0.165
2.....	.20	−111	+ 40	.118	.121
3.....	.28	− 46	+157	.090	.086
4.....	.39	+ 2	−152	.228	.234
5.....	.16	+174	+125	.168	.155
6.....	.28	+180	− 61	+0.245	+0.239
Star A.....	.35	+ 26.6	− 26.2	.....	.....
Star D.....	0.26	+ 20.2	− 30.5	.....	.....

The mean magnitude of the comparison stars is 8.8.

TABLE 2

REDUCTIONS FOR β G.C. 9919 A AND D

Plate	Solution (m)		Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p}\cdot v$ in Arc	
	A	D				A	D
925..	+0.091	+0.019	1.0	−0.909	−227	0".00	0".00
942..	+ .092	+ .016	1.0	− .966	−213	.00	− .01
948..	+ .092	+ .027	0.7	− .974	−207	.00	+ .02
1231..	+ .092	+ .043	1.0	+ .742	+ 17	− .03	+ .05
1238..	+ .098	+ .044	1.0	+ .731	+ 18	− .01	+ .05
1246..	+ .122	− .002	1.0	+ .660	+ 24	+ .05	− .07
1247..	+ .098	+ .002	1.0	+ .660	+ 24	− .01	− .06
1252..	+ .104	+ .040	1.0	+ .648	+ 25	.00	+ .04
1362..	+ .107	+ .046	1.0	− .777	+122	+ .02	+ .05
1374..	+ .081	+ .010	1.0	− .787	+123	− .05	− .05
1390..	+ .118	+ .031	1.0	− .939	+144	+ .05	+ .01
1395..	+0.094	+0.027	1.0	−0.961	+150	−0.02	0.00

The normal equations are:

		A	D
$11.7\,c +$	$0.621\,\mu - 2.580\,\pi$	$= +1.161,$	$= +0.295$
20.253	$+1.559$	$= +0.117,$	$= +0.062$
	7.828	$= -0.230,$	$= -0.060$

from which

A	D
$c = +0.100$	$= +0.025$
$\mu = +0.0025 = +0".007$	$= +0.0023 = +0".006$
$\mu_a = +0".002$	$\mu_a = +0".002$
$\pi = +0.0030 =$	$= +0.0002 =$
$+0".008 \pm 0".008$	$+0".000 \pm 0".012$

Probable error corresponding to unit weight,

$$\pm 0.0081 = \pm 0".022 \qquad \pm 0.0121 = \pm 0".032$$

B.D. +43°3571 (20^h17^m, +43°34′)

This seventh-magnitude star has a spectrum of type V. Twelve plates of this star have been secured as described in Table 1. They were measured by Mr. Joy.

TABLE 1

PLATES OF B.D. +43°3571

No.	Date	Hour Angle	Observers	Quality of Images
938.....	1912 Oct. 6	−0h1	Sl, M	Fair
939.....	Oct. 12	−0.4	M, Si	Good
943.....	Oct. 13	−0.1	M, Si	Good
1232.....	1913 May 31	−0.7	Su, Si	Good
1245.....	June 5	−0.4	Su, Si	Poor
1248.....	June 7	0.0	Su, Si	Poor
1253.....	June 8	−0.3	Su, M	Fair
1258.....	June 12	−0.4	Su, M	Fair
1363.....	Sept. 13	−0.1	Su, Si	Fair
1375.....	Sept. 14	−0.3	Su, Si	Good
1385.....	Sept. 27	−0.1	Su, Si	Fair
1396.....	Oct. 11	−0.1	Si	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
1.....	0.21	+164	−104	+0.142
2.....	.26	+223	+217	.179
3.....	.31	−158	+166	.267
4.....	.15	−179	− 87	.231
5.....	.11	− 50	−192	+0.181
Parallax star...	0.29	− 29.6	+ 13.6	.....

The mean magnitude of the comparison stars is approximately 10.1. The rotating disk was used to cut down the light of the parallax star.

TABLE 2

REDUCTIONS FOR B.D. +43°3571

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
938....	−0.198	0.8	−0.922	−218	+0.007	+0″.02
939....	.177	1.0	− .947	−212	− .013	− .03
943....	.197	1.0	− .951	−211	+ .006	+ .02
1232....	.199	0.9	+ .778	+ 19	+ .017	+ .04
1245....	.183	0.4	+ .725	+ 24	+ .001	.00
1248....	.179	0.3	+ .702	+ 26	− .003	.00
1253....	.152	0.6	+ .691	+ 27	− .030	− .06
1258....	.184	0.8	+ .642	+ 31	+ .002	.00
1363....	.192	0.7	− .734	+124	+ .005	+ .01
1375....	.198	1.0	− .744	+125	+ .010	+ .03
1385....	.189	0.6	− .863	+138	+ .001	.00
1396....	−0.172	0.8	−0.943	+152	−0.016	−0.04

The normal equations are:

$$+8.900\,c - 1.055\,\mu - 3.037\,\pi = -1.660$$
$$18.570 + 2.722 = +0.220$$
$$6.089 = +0.588$$

from which

$$c = -0.185$$
$$\mu = +0.0027 = +0″.007 = +0^s.001 \text{ per year}$$
$$\pi = +0.0040 = +0″.011 \pm 0″.010$$

Probable error corresponding to unit weight,

$$\pm 0.0085 = \pm 0″.022$$

8 β Cephei (21^h27^m, $+70°7'$)

This helium star of magnitude 3.3 is famous as the spectroscopic binary of shortest known period, 4^h34^m. Its binary nature was announced by Frost in the *Astrophysical Journal*, Vol. XV (1902), p. 340, and its period in Vol. XXIV (1906), p. 259, of the same journal. The thirteen plates secured for the parallax determination are described in Table 1. They were measured by Mr. Lee.

TABLE 1

PLATES OF 8 β CEPHEI

No.	Date	Hour Angle	Observers	Quality of Images
260.....	1910 June 18	−0h7	Su, Si	Fair
313.....	Oct. 8	−0.1	Su, Si	Poor
431.....	1911 June 17	−1.5	Su, Si	Good
941.....	1912 Oct. 12	−0.2	Su, M	Fair
983.....	Nov. 9	0.0	Si, M	Good
994.....	Nov. 16	−0.3	M, Si	Good
1272.....	1913 June 22	−0.3	Su, M	Poor
1273.....	June 22	+0.1	Su, M	Poor
1281.....	June 28	−0.3	Su, M	Fair
1282.....	June 28	+0.1	Su, M	Fair
1392.....	Oct. 5	−0.7	Su, Si	Fair
1421.....	Nov. 1	−0.5	Sl	Good
1611.....	1914 July 4	0.0	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.22	−356	−127	+0.086
2.....	0.46	−342	− 40	.129
3.....	0.16	−315	+217	.257
4.....	0.25	+218	−224	.069
5.....	0.29	+393	+111	.241
6.....	0.23	+402	+ 63	+0.218
Parallax star...	1.04	+ 41.8	+ 64.8	.....

The mean magnitude of the comparison stars is 9.6. The sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR 8 β CEPHEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
260....	−0.054	0.7	+0.763	−877	−0.025	−0″.06
313....	− .051	0.4	− .781	−765	+ .032	− .05
431....	− .004	1.0	+ .776	−513	+ .020	+ .05
941....	− .022	0.7	− .819	− 30	− .013	− .03
983....	+ .003	1.0	− .940	− 2	+ .011	+ .03
994....	+ .012	1.0	− .935	+ 5	+ .020	+ .05
1272....	+ .020	0.4	+ .720	+223	+ .035	+ .06
1273....	+ .018	0.4	+ .720	+223	+ .033	+ .05
1281....	− .008	0.7	+ .652	+229	+ .006	+ .01
1282....	− .020	0.7	+ .652	+229	− .006	− .01
1392....	− .006	0.7	− .755	+328	− .001	.00
1421....	− .010	1.0	− .926	+355	− .007	− .02
1611....	−0.040	1.0	+0.581	+600	−0.031	−0.08

The normal equations are:

$$\begin{aligned} 9.7\,c + \ 2.327\,\mu - 0.835\,\pi &= -0.121 \\ 171.084 \ - 4.291 \ &= +0.213 \\ 6.085 \ &= -0.031 \end{aligned}$$

from which

$$c = -0.013$$
$$\mu = +0.0013 = +0''.003 = +0^{s}.002 \text{ per year}$$
$$\pi = -0.0059 = \mathbf{-0''.016 \pm 0''.014}$$

Probable error corresponding to unit weight,

$$\pm 0.0133 = \pm 0''.035$$

B.D. 29°4753 ($22^{h}41^{m}$, +29°54′)

This is a star, Oxford +29°, No. 66606, for which Bellamy gives a proper motion of 0″.44 per year and a photographic magnitude of 6.0. See *Monthly Notices of the Royal Astronomical Society*, Vol. LXXI, (1911), p. 584. The fourteen plates secured for the parallax determination were measured by Mr. Lee.

TABLE 1

PLATES OF B.D. 29°4753

No.	Date	Hour Angle	Observers	Quality of Images
567	1911 Dec. 5	$-0^{h}1$	Sl, V	Good
811	1912 July 7	+0.2	Su, M	Fair
969	Oct. 27	0.0	Su, Sl	Poor
987	Nov. 10	+0.1	Su, Sl	Good
997	Nov. 16	−0.1	M, Sl	Good
1283	1913 June 28	−1.0	Su, M	Fair
1284	June 28	−0.6	Su, M	Fair
1296	July 5	−1.3	Su, M	Poor
1409	Oct. 25	−0.2	Sl	Good
1424	Nov. 1	−0.2	Su, Sl	Good
1429	Nov. 9	−0.4	Sl, Su	Fair
1621	1914 July 12	−0.3	Su, L	Good
1626	July 15	−0.3	Su, L	Fair
1634	July 25	+0.3	Su, L	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.25	−281	−148	+0.143
2	.18	−273	+122	.101
3	.27	−142	+125	.179
4	.12	+ 18	−252	.096
5	.26	+ 98	+256	.180
6	.20	+213	−355	.058
7	.18	+367	+252	+0.153
Parallax star	0.28	− 30.2	+ 64.4	

The mean magnitude of the comparison stars is 10.0. The sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR B.D. 29°4753

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
567	−0.204	1.0	−0.011	−565	−0.003	−0″.01
811	.235	0.7	+ .752	−350	− .003	− .01
969	.254	0.3	− .759	−238	+ .019	+ .03
987	.290	1.0	− .860	−224	− .013	− .03
997	.254	1.0	− .887	−218	+ .025	+ .07
1283	.311	0.7	+ .830	+ 6	.000	.00
1284	.317	0.7	+ .830	+ 6	− .006	− .01
1296	.325	0.4	+ .773	+ 13	− .012	− .02
1409	.348	1.0	− .739	+125	+ .006	+ .02
1424	.359	1.0	− .799	+132	− .003	− .01
1429	.382	0.7	− .853	+140	− .024	− .05
1621	.371	1.0	+ .707	+385	+ .026	+ .07
1626	.408	0.7	+ .676	+388	− .010	− .02
1634	−0.416	0.7	+0.557	+398	−0.014	−0.03

The normal equations are:

$$\begin{aligned} 10.9\,c - \ 0.196\,\mu - \ 1.453\,\pi &= -3.480 \\ 93.104 \ + 11.112 \ &= -1.909 \\ 6.859 \ &= +0.284 \end{aligned}$$

from which

$$c = -0.318$$
$$\mu = -0.0224 = -0''.060 = -0^{s}.017 \text{ per year}$$
$$\pi = +0.0102 = \mathbf{+0''.027 \pm 0''.011}$$

Probable error corresponding to unit weight,

$$\pm 0.0098 = \pm 0''.026$$

SUMMARY OF RESULTS FOR 17 STARS (LEE AND JOY)

Star	R.A. 1900	Decl. 1900	B.D. Number	Magnitude and Spectrum	Proper Motion	Relative Parallax	Probable Error	No. of Plates	Probable Error of One Plate	No. of Comp. Stars
26 β Persei	$3^{h}\ 2^{m}$	+40° 34′	+40°673	2.3 to 3.4, B8	0″.01	+0″.020	±0.014	13	±0.035	3
14 e Canis Majoris	6 49	−11 55	−11 1081	4.5, K5	0.18	+ .012	.007	11	.016	5
Lalande 15565	7 54	+29 31	+29 1664	7.5, G7	0.12	+ .055	.013	10	.026	5
D'Agelet 1623	8 49	+26 35	+26 1865	7	0.43	+ .012	.010	12	.025	3
A.Oe. 10040	10 7	+53 1	+53 1395	9.0	0.70	+ .069	.009	13	.020	5
Lalande 23223	10 20	− 3 44	− 3 3280	8.0	1.34	+ .061	.010	10	.018	5
A.G. Berlin B 5072	14 21	+24 0	+24 2733	9.0	1.40	+ .070	.010	14	.022	6
A.G. Berlin B 5073				9.1	1.40	+ .065	.008	14	.018	6
Lalande 27744	15 9	− 1 0	− 0 2944	7.0, G7	1.40	+ .057	.007	14	.018	6
10 A Ophiuchi	16 26	+ 2 12	+ 2 3118	3.8, A0	0.10	+ .016	.003	13	.008	4
U Ophiuchi	17 14	+ 1 18	+ 1 3408	6.0 to 6.7, B8	0.05	− .011	.004	12	.008	6
Draconis 205	18 45	+49 19	+49 2871	7.0	0.10	+ .012	.008	13	.020	5
β G.C. 9910 A	20 2	+35 30	+35 3957	8.2		+ .008	.008	12	.022	6
D			+35 3956	8.9		+ .000	.012	12	.032	6
B.D. +43°3571	20 17	+43 34	+43 3571	7.5, Oa	0.06	+ .011	.010	12	.022	5
8 δ Cephei	21 27	+70 7	+69 1173	3.5, B1	0.01	− .016	.014	13	.035	6
B.D. +29°4753	22 41	+29 54	+29 4753	6.0	0.44	+0.027	±0.011	14	±0.026	7

PARALLAXES OF TWENTY-SIX STARS

PARALLAXES OF TWENTY-SIX STARS

By Oliver J. Lee and Georges Van Biesbroeck

The parallaxes in this list have been derived in the same manner as those given in earlier lists published by this observatory. Mr. Georges Van Biesbroeck, of the Royal Observatory of Belgium, situated at Uccle, was visiting professor of practical astronomy at this observatory for the year 1915–16. The significance of the abbreviations in the column headed "Observers" is: F = P. Fox, J = A. H. Joy, L = Lee, M = S. A. Mitchell, Sl = F. Slocum, V B = Van Biesbroeck, Su = F. R. Sullivan, V = A. van Maanen.

Miss Eudora Magill, until July 1, 1916, a member of the observatory staff, did much of the computing.

6 Persei (2^h7^m, $+50°36'$)

According to Boss's *Preliminary General Catalogue*, this star has an annual proper motion of

$$\mu = +0^s.0365\ (+0''.347) \qquad \mu' = -0''.168$$

or nearly 0″.4 in arc.

The spectral type is G 5. The magnitude, according to the *Potsdamer Durchmusterung*, is 5.44. The brightness has been reduced nearly 5 magnitudes by using the rotating sector.

The fifteen plates described below were measured by Mr. Van Biesbroeck.

TABLE 1

Plates of 6 Persei

No.	Date	Hour Angle	Observers	Quality of Images
542	1911 Oct. 28	-0^h7	Su, V	Fair*
620	1912 Jan. 1	−0.5	Sl, Su	Fair
628	Jan. 8	−0.7	V, Sl	Fair
860	Aug. 17	−0.6	Su, Sl	Good
863	Aug. 24	−1.2	Su, Sl	Fair
870	Aug. 25	−1.4	Su, M	Poor
1025	Dec. 8	−0.8	Su, Sl	Fair
1038	Dec. 21	−0.4	Su, Sl	Good
1057	1913 Jan. 4	−0.4	Sl	Good
1346	Aug. 21	−0.5	Su	Good
1350	Aug. 23	−0.5	Su	Poor
1451	Dec. 13	−0.9	Su, Sl	Good
1464	Dec. 20	−0.6	Su, Sl	Good
2196	1915 Aug. 18	−0.1	Su, J	Good
2205	Aug. 21	0.0	Su	Fair

* One exposure only.

COMPARISON STARS

No.	Cat.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
		mm			
1	18	0.12	−258	− 18	+0.209
2	29	.10	−127	+192	.222
3	56	.13	+ 41	−160	.184
4	80	.11	+154	−153	.180
5	87	.09	+190	+139	+0.205
Parallax star	45	0.17	− 8.0	+ 10.5	.....

The second column "Cat." gives the number of the stars on plate $\alpha = 2^h12^m$, $\delta = +50°$ of the *Catania Astrographic Catalogue*.

The mean magnitude of the comparison stars is 10.2.

TABLE 2

Reductions for 6 Persei

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
542	−0.213	0.5	−0.007	−531	−0.023	−0″.04
620	− .144	0.7	− .846	−466	+ .021	+ .05
628	− .174	0.7	− .886	−459	− .012	− .03
860	− .080	1.0	+ .890	−237	+ .008	+ .02
863	− .084	0.7	+ .843	−230	+ .001	.00
870	− .047	0.4	+ .836	−229	+ .038	+ .06
1025	− .068	0.7	− .625	−124	− .024	− .05
1038	− .052	1.0	− .764	−111	− .013	− .03
1057	− .034	1.0	− .869	− 97	.000	.00
1346	+ .034	1.0	+ .866	+132	− .010	− .03
1350	+ .048	0.3	+ .852	+134	+ .004	+ .01
1451	+ .094	1.0	− .680	+246	+ .006	+ .02
1464	+ .112	1.0	− .752	+253	+ .022	+ .06
2196	+ .292	1.0	+ .888	+859	− .010	− .03
2205	+0.306	0.7	+0.870	+862	+0.003	+0.01

The normal equations are:

$$\begin{aligned} 11.7\,c + \ 4.362\,\mu - \ 0.285\,\pi &= +0.140 \\ 199.248 + 14.414 &= +7.045 \\ 7.546 &= +0.496 \end{aligned}$$

from which

$$c = 0.0013$$
$$\mu = +0.0355 = +0''.095 \qquad \mu_a = +0^s.036$$
$$\pi = -0.0023 = -0''.006 \pm 0''.010$$

Probable error corresponding to unit weight,

$$\pm 0.0098 = \pm 0''.026$$

If, instead of deducing μ from the measures, we adopt the value given by Boss, the resulting value of π is $-0''.003 \pm 0''.007$. No previous determinations of parallax are available.

β G.C. 2745 (5^h23^m, $+54°35'$)

The components of this double star, Σ711, estimated respectively as of magnitudes 7.5 and 9.2 by W. Struve, have shown very little relative motion since his first measures in 1830. Allowing for precession, the angular motion is only $-0''.05$ per year and $-0''.007$ in distance. Meridian observations indicate an appreciable proper motion for the primary stars:

Observer	μ_α	μ_δ	Epoch*
Küstner (Bonn *Veröffentlichungen*, No. 2)	$-0^s.0154$	$-0''.404$	1888
Porter (Cincinnati *Publications*, Vol. XII)	− .018	− .40	1890
Porter (Cincinnati *Publications*, Vol. XIII)	− .0178	− .405	1892
Simonin (Nice *Annales*, Vol. XIV)	−0.016	−0.41	1896

* Of the last observations used in each determination.

To that proper motion corresponds a change of more than half a minute of arc in the position of the primary star since Struve. The pair must be considered therefore as a physical system.

This is one of the stars that R. S. Ball included in his search for measurable parallaxes in 1881 (Dunsink, *Astronomical Observations*, Vol. V), but he could not detect any evidence of parallax.

The twelve plates described in Table 1 were measured by Mr. Van Biesbroeck.

TABLE 1

PLATES OF β G.C. 2745

No.	Date	Hour Angle	Observers	Quality of Images
1748	1914 Oct. 24	$+0^h1$	Su, L	Good
1779	Nov. 1	−0.2	Su, L	Fair
1793	Nov. 4	−0.1	Su, J	Fair
1931	1915 Feb. 7	−0.2	Su, J	Good
1939	Feb. 10	−0.1	Su, J	Fair
1948	Feb. 25	−0.1	J	Fair
1954	Feb. 27	−0.5	J, L	Good
1978	Mar. 7	+0.1	L, J	Fair
2287	Oct. 10	−0.2	Su, L	Poor
2324	Oct. 28	−0.1	V B, Su	Fair
2466	1916 Feb. 27	−0.2	V B	Good
2467	Feb. 27	0.0	V B	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence		
				A	B	Adopted for both Stars
	mm					
1	0.25	−272	+189	+0.253	+0.253	+0.253
2	.30	−172	−161	.235	.240	.238
3	.39	+ 26	+149	.194	.191	.192
4	.46	+ 84	−236	.185	.188	.186
5	.25	+334	+ 59	0.133	0.128	+0.131
Parallax star A	.50	− 44.3	+ 2.9	.....	.....	.....
B	0.30	− 46.7	+ 0.9	.....	.....	.....

The mean magnitude of the comparison stars is 9.3.

TABLE 2

REDUCTIONS FOR β G.C. 2745

Plate	Solution (m)		Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p}\cdot\varepsilon$ in Arc	
	A	B				A	B
1748	+0.129	−0.288	1.0	+0.768	−193	0''.00	+0''.02
1779	.151	.295	0.7	+ .672	−185	+ .05	.00
1793	.120	.314	0.7	+ .633	−182	− .02	− .04
1931	.085	.319	1.0	− .820	− 87	− .04	− .01
1939	.108	.313	0.7	− .848	− 84	+ .02	.00
1948	.090	.312	0.7	− .952	− 69	− .02	+ .01
1954	.094	.308	1.0	− .961	− 67	− .01	+ .02
1978	.109	.322	0.7	− .986	− 59	+ .03	− .01
2287	.076	.334	0.4	+ .902	+158	− .01	.00
2324	.066	.328	0.7	+ .725	+176	− .02	+ .02
2466	.041	.362	1.0	− .960	+298	− .01	− .01
2467	+0.053	−0.360	1.0	−0.960	+298	+0.03	0.00

The normal equations are:

	A	B
$9.6\,c+\ 0.301\,\mu-3.101\,\pi$	$=+0.883,$	$=-3.089$
$31.644\ -4.694$	$=-0.477,$	$=-0.477$
7.137	$=-0.165,$	$=+1.081$

from which

A

$c=+0.095$

$\mu=-0.0147=-0''.039$ $\qquad \mu_\alpha=-0^s.016$

$\pi=+0.0085=+0''.023\pm0''.008$

B

$c=-0.320$

$\mu=-0.0113=-0''.030$ $\qquad \mu_\alpha=-0^s.013$

$\pi=+0.0050=+0''.013\pm0''.005$

Probable error corresponding to unit weight,

$\pm0.0073=\pm0''.019$ $\qquad \pm0.0048=\pm0''.013$

The probable error is larger for the primary star than for the companion. The difference may be accounted for in the following way: the exposures having been made without using the rotating sector, the image of the primary is somewhat overexposed, while that of the companion is well timed. There is no reason for admitting a difference between the parallaxes of the two components. Combining the two independent determinations according to the weight we find for the most probable value of the parallax of the system: $+0''.016\pm0''.004$.

Argelander-Oeltzen 7846 (7^h18^m, $+46°18'$)

This is one of the 150 stars for which proper motions have been deduced by Ristenpart in the *Astronomische Nachrichten*, Vol. CLXXVII (1908), p. 23. He gives:

$\mu=-0^s.028$ $\qquad \mu'=-0''.32$

According to the *B.D.* its magnitude is 8.9; in the *A.G.* zones it is estimated as 9.0.

This parallax is based on the twelve plates measured by Mr. Van Biesbroeck.

TABLE 1

PLATES OF A.OE. 7846

No.	Date	Hour Angle	Observers	Quality of Images
683.....	1912 Mar. 3	-0^h3	Su, Sl	Good*
956.....	Oct. 19	−0.1	Su, Sl	Fair
979.....	Nov. 2	0.0	Su, Sl	Good
984.....	Nov. 9	−0.8	Su, Sl	Poor
990.....	Nov. 10	−0.6	Su, M	Poor
1165.....	1913 Mar. 9	−0.3	Su, Sl	Good
1417.....	Oct. 30	−0.6	Sl	Fair
1512.....	1914 Mar. 1	−0.5	Su, Sl	Fair
1751.....	Oct. 24	−0.1	Su, L	Fair†
1958.....	1915 Feb. 27	−0.1	Su, L	Good
1989.....	Mar. 10	−0.8	L	Fair
2328.....	Oct. 28	0.0	V B, Su	Good

* Thick clouds.
† First exposure: images elongated.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.24	−265	− 56	+0.187
2.....	.23	−105	+125	.193
3.....	.19	− 15	−147	.201
4.....	.14	+ 66	+126	.202
5.....	.18	+319	− 48	+0.217
Parallax star...	0.31	+ 9.9	− 0.7	.....

The mean magnitude of the comparison stars is 10.4.

TABLE 2

REDUCTIONS FOR A.OE. 7846

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
683....	+0.353	1.0	−0.805	−598	+0.003	+0″.01
956....	.289	0.7	+ .975	−368	− .002	− .01
979....	.290	1.0	+ .908	−354	+ .003	+ .01
984....	.288	0.4	+ .854	−347	+ .004	+ .01
990....	.287	0.4	+ .845	−346	+ .003	.00
1165....	.225	1.0	− .859	−227	− .014	− .04
1417....	.184	0.7	+ .929	+ 8	+ .005	+ .01
1512....	.130	0.7	− .779	+130	− .002	.00
1751....	.072	0.7	+ .960	+367	+ .001	.00
1958....	.030	1.0	− .755	+493	+ .007	+ .02
1989....	+ .028	0.7	− .863	+504	+ .008	+ .02
2328....	−0.048	1.0	+0.942	+736	−0.008	−0.02

The normal equations are:

$$9.3\,c + 2.215\mu + 0.966\pi = +1.572$$
$$+179.401 \quad +0.659 = -4.983$$
$$+7.106 = +0.191$$

from which

$$c = 0.176$$
$$\mu = -0.0300 = -0''.080 \qquad \mu_a = -0^s.028$$
$$\pi = +0.0058 = +0''.015 \pm 0''.005$$

Probable error corresponding to unit weight,

$$\pm 0.0045 = \pm 0''.012$$

75 σ Geminorum (7^h37^m, +29°8′)

This fourth-magnitude star is of spectral class K. The proper motion, according to Boss, is

$$\mu = +0^s.0053 \qquad \mu' = -0''.237$$

or 0″.25 per year.

The measures are by Mr. Van Biesbroeck.

TABLE 1

PLATES OF 75 σ GEMINDRUM

No.	Date	Hour Angle	Observers	Quality of Images
80.....	1908 Nov. 28	-0^h5	F, Su	Good
336.....	1910 Oct. 22	−1.1	Su, Sl	Fair
1976.....	1915 Mar. 3	−0.6	Su, L	Poor
1998.....	Mar. 11	−0.4	Su, J	Poor*
2029.....	Mar. 28	0.0	J	Fair
2038.....	Mar. 31	+0.1	L	Good
2345.....	Nov. 4	−0.5	Su, L	Fair
2356.....	Nov. 7	0.0	Su, L	Fair
2378.....	Nov. 21	−0.3	Su, L	Poor
2483.....	1916 Mar. 16	−0.1	V B, Su	Good
2496.....	Mar. 30	+0.2	V B	Good

* Images elongated.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.23	−348	+186	+0.236
2.....	.24	− 47	−157	.248
3.....	.23	+169	+188	.257
4.....	.15	+226	−217	+0.259
Parallax star...	0.30	+ 8.2	− 3.1	.....

The mean magnitude of the comparison stars is 10.0. The rotating sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR 75 σ GEMINORUM

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
80....	−0.136	1.0	+0.699	−2078	+0.002	0″.00
336....	− .090	0.7	+ .975	−1385	− .002	.00
1976....	+ .046	0.4	− .746	+ 208	+ .037	+ .06
1998....	− .009	0.4	− .829	+ 216	− .018	− .03
2029....	− .002	0.7	− .949	+ 233	− .011	− .02
2038....	+ .004	1.0	− .962	+ 236	− .005	− .01
2345....	+ .039	0.7	+ .923	+ 454	+ .002	.00
2356....	+ .013	0.7	+ .904	+ 457	− .024	− .05
2378....	+ .076	0.4	+ .785	+ 471	+ .039	+ .06
2483....	+ .037	1.0	− .878	+ 581	+ .004	+ .01
2496....	+0.036	1.0	−0.961	+ 601	+0.002	+0.01

The normal equations are:

$$\begin{aligned} 8.0\,c - 4.647\mu - 1.121\pi &= -0.042 \\ 687.549 - 32.758 &= +4.478 \\ 6.317 &= -0.180 \end{aligned}$$

from which

$$c = -0.000$$
$$\mu = +0.0068 = +0''.018 \qquad \mu_a = +0^s.005$$
$$\pi = +0.0070 = +0''.019 \pm 0''.013$$

Probable error corresponding to unit weight,

$$\pm 0.0102 = \pm 0''.027$$

The parallax of this star has been measured previously by Jost (*Veröffentlichungen*, Heidelberg, Astronomisches Institut, Vol. IV, p. 118), with the Heidelberg meridian circle. The mean of his determinations is:

$$\pi = +0''.052 \pm 0''.027$$

W Ursae Majoris (9^h37^m, $+56°25'$)

This variable was discovered by Müller and Kempf in 1903. The period found by them, 4^h0^m, has since been shown to be half of the real period. Russell has published two limiting uniform solutions, based on the Potsdam observations of Müller and Kempf, and of Baldwin, in the *Astrophysical Journal*, Vol. XXXVI (1912), p. 139. The elements from these, as well as a set of elements on the assumption of darkened limb, are given in *Princeton Contributions*, No. 3, p. 82. The following elements are of especial interest:

Period, 0.334 days.

Maximum, 7.91 magnitude.

Range, 0.60 magnitude.

The density is the greatest known for any eclipsing variable. A hypothetical parallax of $0''.020$ was computed. The spectral type is G. The fourteen plates discussed here were measured by Mr. Lee.

TABLE 1

PLATES OF W URSAE MAJORIS

No.	Date	Hour Angle	Observers	Quality of Images
1151	1913 Mar. 6	$-0^h.2$	Su, Sl	Good
1445	Nov. 23	−0.6	Su, Sl	Poor
1461	Dec. 14	−0.3	Su, Sl	Poor
1548	1914 Apr. 4	−0.5	Su, Sl	Good
1557	Apr. 11	−0.3	Su, Sl	Good
1564	Apr. 16	−0.2	Su, L	Fair
1857	Nov. 26	−0.3	Su, L	Good
1992	1915 Mar. 10	−0.5	Su, L	Good
2001	Mar. 11	−0.4	Su, J	Fair
2376	Nov. 14	−0.2	Su, L	Good
2385	Nov. 28	−0.4	Su, L	Good
2389	Dec. 1	−0.4	V B, Su	Good
2396	Dec. 9	+0.1	Su, L	Fair
2402	1916 Jan. 2	−0.2	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.07	−336	−320	+0.213
2	.26	−273	+327	.226
3	.09	−127	+101	.211
4	.08	+330	+150	.183
5	.27	+406	−258	+0.167
Parallax star	0.14	− 31.5	+ 11.5	

The mean magnitude of the comparison stars is approximately 11. The apparent magnitude of the parallax star was reduced about $2\frac{1}{2}$ magnitudes by means of the sector.

TABLE 2

REDUCTIONS FOR W URSAE MAJORIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
1151	+0.384	1.0	−0.381	−633	+0.007	+0''.02
1445	+ .386	0.3	+ .921	−371	− .004	− .01
1461	+ .383	0.4	+ .800	−350	− .007	− .01
1548	+ .373	1.0	− .750	−239	− .016	− .04
1557	+ .412	1.0	− .816	−232	+ .023	+ .06
1564	+ .368	0.7	− .855	−227	− .021	− .05
1857	+ .401	0.7	+ .012	− 3	− .001	.00
1992	+ .410	1.0	− .433	+101	+ .008	+ .02
2001	+ .396	0.7	− .448	+102	− .006	− .01
2376	+ .420	1.0	+ .933	+350	+ .006	+ .02
2385	+ .416	1.0	+ .905	+364	+ .002	.00
2389	+ .408	1.0	+ .891	+367	− .006	− .02
2396	+ .416	0.7	+ .841	+375	+ .001	.00
2402	+0.415	1.0	+0.603	+399	0.000	0.00

The normal equations are:

$$\begin{aligned} 11.5\,c + 3.986\mu + 1.865\pi &= +4.614 \\ 130.281 + 18.983 &= +2.089 \\ 6.650 &= +0.829 \end{aligned}$$

from which

$$c = +0.400$$
$$\mu = +0.0034 = +0''.009 \qquad \mu_a = +0^s.004$$
$$\pi = +0.0029 = +0''.008 \pm 0''.010$$

Probable error corresponding to unit weight,

$$\pm 0.0075 = \pm 0''.020$$

Lalande 22667 (11^h59^m, $+3°55'$)

This ninth-magnitude star has a proper motion of $0''.55$ in $173°.8$, made up of $+0^s.004$ and $-0''.55$ according to Porter (*Astronomical Journal*, Vol. XII

[1892], p. 25). The twelve plates described in Table 1 were measured by Mr. Lee.

TABLE 1

PLATES OF LALANDE 22667

No.	Date	Hour Angle	Observers	Quality of Images
744.....	1912 Apr. 14	+0^{h}1	Sl, Su	Good
1105.....	1913 Feb. 6	−1.4	Su, M	Good
1569.....	1914 Apr. 25	−0.7	Su, L	Good
1582.....	May 16	0.0	Su, L	Fair
1874.....	Dec. 16	+0.2	Su, J	Fair
1920.....	1915 Jan. 23	+0.1	Su, J	Good
2066.....	Apr. 28	+0.4	Su, L	Fair
2076.....	May 5	+0.2	Su, J	Good
2399.....	Dec. 9	−0.5	Su, L	Fair
2400.....	Dec. 9	−0.2	L	Poor
2405.....	1916 Jan. 2	−0.4	Su, L	Good
2406.....	Jan. 2	−0.1	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.21	−270	−172	+0.229
2.....	.10	−267	+346	.212
3.....	.26	− 68	+ 7	.206
4.....	.31	+311	+ 32	.172
5.....	.16	+294	−213	+0.181
Parallax star...	0.22	− 25.8	+ 2.2	.....

The mean magnitude of the comparison stars is 9.4.

TABLE 2

REDUCTIONS FOR LALANDE 22667

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
744....	−0.115	1.0	−0.388	−950	−0.022	−0″.06
1105....	− .038	1.0	+ .605	−652	+ .020	+ .05
1569....	− .008	1.0	− .531	−209	+ .008	+ .02
1582....	− .004	0.7	− .764	−188	+ .011	+ .02
1874....	+ .026	0.7	+ .899	+ 26	+ .012	+ .03
1920....	+ .008	1.0	+ .754	+ 64	− .009	− .03
2066....	+ .031	0.7	− .567	+159	+ .009	+ .02
2076....	+ .016	1.0	− .650	+166	− .006	− .02
2399....	+ .057	0.7	+ .882	+384	+ .006	+ .01
2400....	+ .048	0.4	+ .882	+384	− .003	− .01
2405....	+ .028	1.0	+ .883	+408	− .026	− .07
2406....	+0.064	1.0	+0.883	+408	+0.010	+0.03

The normal equations are:

$$10.2\,c - 3.447\,\mu + 2.224\,\pi = +0.051$$
$$194.098 + 11.724 = +2.036$$
$$5.404 = +0.161$$

from which

$$c = +0.008$$
$$\mu = +0.0104 = +0″.028 \qquad \mu_\alpha = +0^s.007$$
$$\pi = +0.0042 = +0″.011 \pm 0″.014$$

Probable error corresponding to unit weight,

$$\pm 0.0103 = \pm 0″.028$$

Argelander-Oeltzen 14318–20 (15^h5^m, $-15°59'$; 15^h5^m, $-15°54'$)

These two stars are 5′ apart but have motions that are strikingly similar. Professor Porter has been kind enough to send his latest values of the proper motions, $-0^s.0696$ and $-0^s.0683$, $-3″.555$ and $-3″.540$, total motion, $3″.693$ in $195°.7$ and $3″.675$ in $195°.6$, respectively. In a recent note (*Popular Astronomy*, Vol. XXIV [1916], p. 266) Adams gives magnitudes 9.6 and 9.2, spectral types G 5 and G 4, and radial velocities from low dispersion spectrogram +307 km and 295 km, respectively. The ten plates described in Table 1 were measured by Mr. Lee. A note concerning this pair of stars was published in the *Astronomical Journal*, Vol. XXX (1916), p. 6.

TABLE 1

PLATES OF A.OE. 14318–20

No.	Date	Hour Angle	Observers	Quality of Images
719.....	1912 Mar. 24	−1^{h}6	Sl, V	Good
723.....	Apr. 2	−0.4	Sl, Su	Good
1274.....	1913 June 26	−0.1	Sl, M	Good
1293.....	July 5	+0.4	Su, M	Fair
1495.....	1914 Feb. 14	−0.1	Su, Sl	Fair
1502.....	Feb. 15	−0.4	Su, Sl	Fair
1515.....	Mar. 1	−0.1	Su, Sl	Good
1532.....	Mar. 14	−0.5	Su, Sl	Good
2117.....	1915 June 20	+0.4	Su, J	Fair
2126.....	June 27	+0.1	Su, J	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence	
				A	B
	mm				
1.....	0.09	−195	−227	+0.253	+0.098
2.....	.12	−166	+ 86	.193	.234
3.....	.18	−117	+255	.152	.302
4.....	.24	+228	+108	.092	.176
5.....	.09	+ 54	− 1	.154	.157
6.....	.06	+196	−221	+0.156	+0.033
Parallax star A	.24	− 39.3	− 26.6	.....	.....
B	0.27	− 38.1	+ 86.3	.....	.....

The mean magnitude of the comparison stars is 10.6.

TABLE 2

REDUCTIONS FOR A.OE. 14318–20

Plate	Solution (m)		Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p}\cdot v$ in Arc	
	A	B				A	B
719..	+1.213	+1.427	1.0	+0.673	−612	−0″.02	0″.00
723..	+1.220	1.421	1.0	+ .560	−603	+ .02	+ .02
1274..	+0.735	0.921	1.0	− .703	−153	+ .01	− .01
1293..	+0.718	0.906	0.7	− .797	−144	− .01	− .01
1495..	+0.496	0.695	0.7	+ .943	+ 80	− .02	− .06
1502..	+0.522	0.712	0.7	+ .941	+ 81	+ .04	− .02
1515..	+0.490	0.706	1.0	+ .883	+ 95	.00	+ .01
1532..	+0.468	0.706	1.0	+ .782	+108	− .02	+ .05
2117..	−0.016	0.202	0.7	− .626	+571	+ .01	+ .05
2126..	−0.030	+0.158	1.0	−0.709	+578	−0.01	−0.03

The normal equations are:

	A	B
$8.8c - 1.754\mu + 1.809\pi = +5.300,$	$= +7.100$	
$136.815 \quad -9.472 = -15.321,$	$= -15.678$	
$5.116 = +2.080,$	$= +2.506$	

from which

A

$c = +0.580$
$\mu = -0.1039 = -0''.276 \quad \mu_\alpha = -0^s.070$
$\pi = +0.0094 = +0''.025 \pm 0''.008$

B

$c = +0.782$
$\mu = -0.1030 = -0''.274 \quad \mu_\alpha = -0^s.069$
$\pi = +0.0228 = +0''.061 \pm 0''.012$

Probable error corresponding to unit weight,

$\pm 0.0058 = \pm 0''.015 \qquad \pm 0.0095 = \pm 0''.025$

Russell's parallaxes are

$+0''.014 \pm 0''.023$ and $+0''.045 \pm 0''.022$ respectively.

13 δ Serpentis (15^h30^m, $+10°53'$)

This bright double star has components of magnitude 5.2 and 4.2. The relative motion is small and the proper motion of the system is $-0^s.0046$ and $+0''.008$, according to Boss. The spectral type is A 5. Variable radial velocity in the system was announced in *Lick Observatory Bulletin*, Vol. VI (1910–11), p. 146. Four unpublished observations at the Yerkes Observatory accidentally fell on such dates in 1907, 1908, 1909, and 1911 that the extreme values were -37.2 km and -40.9 km.

The ten parallax plates described in Table 1 were measured by Mr. Lee.

TABLE 1

PLATES OF 13 δ SERPENTIS

No.	Date	Hour Angle	Observers	Quality of Images
1943	1915 Feb. 17	$-0^h.2$	Su, L	Fair
1986	Mar. 7	−0.2	Su, L	Fair
2005	Mar. 11	−0.6	Su, L	Good
2106	June 13	−0.1	Su, J	Good
2120	June 26	−0.6	Su, L	Good
2127	June 27	+0.3	Su, J	Good
2129	June 30	−0.3	Su, L	Good
2135	July 1	+0.2	Su, J	Fair
2439	1916 Feb. 2	−0.2	V H	Fair
2458	Feb. 13	−0.2	Su, L	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.25	−311	− 58	+0.416
2	.19	− 2	+268	.333
3	.12	+282	+ 78	.108
4	.10	+ 31	−288	+0.143
Parallax star A	.34	− 95.0	+ 33.0	.....
B	0.22	− 95.1	+ 31.6	.....

The mean magnitude of the comparison stars is 10.5. The sector was used.

TABLE 2

REDUCTIONS FOR 13 δ SERPENTIS

Plate	Solution (m) A	Solution (m) B	Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p}\cdot v$ in Arc A	$\sqrt{p}\cdot v$ in Arc B
1943	+0.140	+0.080	0.7	+0.957	−139	0''.00	0''.00
1986	.153	.084	0.7	+ .895	−121	+ .03	+ .01
2005	.127	.080	0.7	+ .869	−117	− .03	.00
2106	.161	.078	1.0	− .447	− 23	+ .06	+ .01
2120	.138	.069	0.7	− .625	− 10	.00	− .01
2127	.124	.070	1.0	− .639	− 9	− .03	− .01
2129	.138	.082	1.0	− .675	− 6	.00	+ .02
2135	.124	.062	0.7	− .687	− 5	− .03	− .02
2439	.140	.076	0.5	+ .937	+211	+ .01	.00
2458	+0.130	+0.076	0.7	+0.958	+222	−0.01	0.00

The normal equations are:

	A	B
$7.7c - 0.515\mu + 0.364\pi = +1.061,$	$= +0.584$	
$9.085 \quad +0.345 = -0.091,$	$= -0.052$	
$4.479 = +0.055,$	$= +0.046$	

from which

A

$c = +0.138$
$\mu = -0.0022 = -0''.006 \quad \mu_\alpha = -0^s.002$
$\pi = +0.0013 = +0''.004 \pm 0''.011$

B

$c = +0.075$
$\mu = -0.0017 = -0''.004 \quad \mu_\alpha = -0^s.001$
$\pi = +0.0044 = +0''.012 \pm 0''.004$

Probable error corresponding to unit weight,

$\pm 0.0085 = \pm 0''.023 \qquad \pm 0.0037 = \pm 0''.010$

Assuming that the two stars form a binary system and hence lie at nearly the same distances from the sun the parallax is $+0''.011 \pm 0''.004$.

ξ Scorpii (15^h59^m, $-11°6'$)

This interesting triple system was discovered by Sir William Herschel in 1782. The early computers, with the exception of Thiele, all made the period about 100 years. In 1905 Aitken gave the proper orientation of the orbit with a period of 44.5 years,

and again in 1912, with additional observations, revised elements and a period of 44.7 years. From the eleven plates described in Table 1 independent parallaxes of A and B and of C were derived. The measures are by Mr. Lee. The spectral type of A and B is F 8 and their combined mass is 1.06 times that of the sun. The luminosities are: A=4.5, B=3.4, and C=0.5, where the sun's luminosity is unity. Unpublished measures by Lee of eight Bruce spectrograms indicate variable radial velocity ranging from −17 to −35 km per second.

TABLE 1

PLATES OF ξ SCORPII

No.	Date	Hour Angle	Observers	Quality of Images	
				A and B	C
88.....	1909 Mar. 20	−0h1	F, Su	Good	Good
262.....	1910 June 25	−0.1	Su, Sl	Good	Good
724.....	1912 Apr. 2	−0.7	V, Sl	Good	Good
787.....	June 15	−0.4	Su, M	Poor	Poor
1295.....	1913 July 5	+0.7	Su, M	Poor	Poor
1306.....	July 10	+0.5	Su, M	Poor	Poor
1521.....	1914 Mar. 8	−0.3	Su, Sl	Fair	Fair
1522.....	Mar. 8	+0.2	Su, Sl	Poor	Poor
1526.....	Mar. 12	−0.4	Su, Sl	Good	Good
1622.....	July 15	0.0	Su, L	Fair	Poor
1628.....	July 18	+0.3	Su, L	Good	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence	
				A and B	C
	mm				
1.....	0.24	−295	− 11	+0.179	+0.175
2.....	.24	−114	+184	.165	.165
3.....	.13	+ 63	−120	.222	.222
4.....	.12	+107	−235	.242	.241
5.....	.31	+239	+182	+0.192	+0.197
Parallax star, A and B....	.42	+ 14.1	− 20.2	.....	.....
C.....	0.17	+ 16.5	− 18.8	.....	.....

The mean magnitude of the comparison stars is approximately 10.4. The rotating sector was used for the parallax stars.

TABLE 2

REDUCTIONS FOR ξ SCORPII A AND B, AND FOR C

Plate	Solution (m)		Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p}\cdot v$ in Arc	
	A and B	C				A and B	C
88..	+0.126	+0.322	1.0	+0.861	−1362	+0″.05	0″.00
262..	+ .042	.260	1.0	− .523	−.900	− .04	.00
724..	+ .028	.238	1.0	+ .737	− 253	− .03	+ .01
787..	+ .004	.210	0.4	− .383	− 179	− .02	.00
1295..	− .006	.154	0.4	− .660	+ 206	+ .01	− .03
1306..	− .016	.176	0.4	− .719	+ 211	− .01	+ .01
1521..	+ .002	.179	0.7	+ .935	+ 452	.00	− .02
1522..	− .002	.204	0.4	+ .935	+ 452	− .01	+ .03
1526..	+ .004	.182	1.0	+ .915	+ 456	.00	− .01
1622..	− .018	.136	0.7*	− .771	+ 581	+ .04	− .01
1628..	−0.032	+0.152	1.0	−0.801	+ 584	+0.01	+0.02

* C has weight 0.4 on this plate.

The normal equations are:

A and B

$$8.0\,c - 4.759\mu + 0.973\pi = +0.149$$
$$378.667 - 8.753 = -2.425$$
$$4.854 = +0.152$$

C

$$7.7\,c - 6.502\mu + 1.204\pi = +1.631$$
$$368.540 - 7.409 = -4.234$$
$$4.676 = +0.390$$

from which

A and B

$$c = +0.013$$
$$\mu = -0.0058 = -0''.016 \qquad \mu_a = -0^s.004$$
$$\pi = +0.0183 = +0''.049 \pm 0''.009$$

C

$$c = +0.202$$
$$\mu = -0.0075 = -0''.020 \qquad \mu_a = -0^s.005$$
$$\pi = +0.0192 = +0''.051 \pm 0''.006$$

Probable error corresponding to unit weight,

$$\pm 0.0075 = \pm 0''.020 \qquad \pm 0.0051 = \pm 0''.013$$

The parallax of the system is $+0''.050 \pm 0''.005$.

7 κ Herculis (16^h4^m, $+17°19'$)

For the components of this wide double discovered by Herschel, Boss gives the following proper motions: for the brighter star, $-0^s.0031$ and $-0''.014$; for the fainter star, $-0^s.0020$ and $-0''.039$. The slight change in relative position of the two stars is probably all due to difference of proper motion.

The *Revised Harvard Photometry* gives magnitudes 5.3 and 6.5, and K as the spectral type.

The twelve plates used for determining the parallax were measured by Mr. Lee.

TABLE 1

PLATES OF 7 κ HERCULIS

No.	Date	Hour Angle	Observers	Quality of Images
1987.....	1915 Mar. 7	−0h3	Su, L	Good
2020.....	Mar. 17	+0.1	Su, J	Good
2022.....	Mar. 18	−0.2	Su, L	Good
2128.....	June 27	+0.2	Su, J	Good
2130.....	June 30	−0.2	Su, L	Fair
2144.....	July 8	+0.2	Su, L	Good
2145.....	July 8	+0.5	Su, L	Good*
2154.....	July 15	−0.1	Su, L	Good
2155.....	July 15	+0.3	Su	Good
2480.....	1916 Mar. 12	−0.5	Su, L	Good
2492.....	Mar. 16	−0.2	Su, L	Good
2509.....	Apr. 9	−0.4	Su, L	Fair

* One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence A	Dependence B
	mm				
1	0.33	−289	−216	+0.325	+0.308
2	.30	+ 25	+233	.280	.310
3	.20	+264	− 17	+0.395	+0.382
Parallax star A	.23	+ 17.6	− 11.7	.....	.....
B	0.12	+ 19.7	− 0.9	.....	.....

The mean magnitude of the comparison stars is 9.2.

TABLE 2

REDUCTIONS FOR 7 κ HERCULIS

Plate	Solution (m) A	Solution (m) B	Weight (p)	Parallax Factor (P)	Time in Days (t)	$\sqrt{p}\cdot v$ in Arc A	$\sqrt{p}\cdot v$ in Arc B
1987..	+0.238	+0.093	1.0	+0.946	−158	+0″.02	0″.00
2020..	.222	.087	1.0	+ .895	−148	− .02	− .02
2022..	.228	.101	1.0	+ .888	−147	− .01	+ .02
2128..	.240	.103	1.0	− .533	− 46	+ .02	.00
2130..	.240	.090	0.7	− .574	− 43	+ .01	− .03
2144..	.250	.126	1.0	− .677	− 35	+ .04	+ .06
2145..	.211	.104	0.7	− .677	− 35	− .05	.00
2154..	.226	.094	1.0	− .757	− 28	− .02	− .03
2155..	.233	.098	1.0	− .757	− 28	.00	− .02
2480..	.224	.063	1.0	+ .920	+213	.00	− .03
2492..	.233	.084	1.0	+ .897	+217	+ .03	+ .02
2509..	+0.212	+0.080	0.9	+0.670	+241	−0.03	+0.01

The normal equations are:

	A	B
$11.3\,c+\ 0.023\mu+1.549\pi=$	$+2.600,$	$=+1.057$
$22.027\ +2.479\ =$	$-0.048,$	$=-0.132$
$6.980\ =$	$+0.328,$	$=+0.066$

from which

A

$c=+0.231$

$\mu=-0.0020=-0″.005$ $\qquad \mu_a=-0″.001$

$\pi=-0.0035=-0″.009\pm0″.008$

B

$c=+0.095$

$\mu=-0.0050=-0″.013$ $\qquad \mu_a=-0″.003$

$\pi=-0.0098=-0″.026\pm0″.008$

Probable error corresponding to unit weight,

$\pm0.0075=\pm0″.020$ $\qquad \pm0.0074=\pm0″.020$

Weisse-Bessel I, 16^{h}906 (16^{h}50^m, −8°9′)

This ninth-magnitude star has proper motions, −0″.063 and −0″.87, according to Porter (*Astronomical Journal*, Vol. XII [1892], p. 25). The eleven plates described in Table 1 were measured by Miss Julia M. Hawkes of Carleton College.

TABLE 1

PLATES OF W.B. I, 16^{h}906

No.	Date	Hour Angle	Observers	Quality of Images
813.....	1912 July 13	−0^{h}3	Su, M	Fair
1332.....	1913 Aug. 2	+0.1	Su, M	Good
1523.....	1914 Mar. 8	−0.2	Su, Sl	Good
1527.....	Mar. 12	−0.6	Su, Sl	Good
1610.....	July 4	−0.3	Su, L	Fair
1615.....	July 5	0.0	Su, L	Fair
1975.....	1915 Feb. 28	−0.5	Su, L	Fair
2008.....	Mar. 11	−0.4	Su, L	Good
2131.....	June 30	−0.4	Su, L	Good
2136.....	July 1	−0.4	Su, J	Good
2184.....	Aug. 15	+0.7	Su	Good*

* One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.27	−150	− 47	+0.184
2	.08	−171	+186	.198
3	.18	+216	−286	.125
4	.07	+112	+295	.166
5	.07	+109	−220	.142
6	.14	−116	+ 82	+0.185
Parallax star	0.21	− 21.7	+ 23.9	.....

The average magnitude of the comparison stars is 10.4.

TABLE 2

REDUCTIONS FOR W.B. I, 16^{h}906

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ In Arc
813....	+0.382	0.8	−0.612	−751	+0.002	0″.00
1332....	+ .046	1.0	− .837	−366	+ .003	+ .01
1523....	− .057	1.0	+ .984	−148	− .006	− .01
1527....	− .054	0.9	+ .977	−144	+ .001	.00
1610....	− .224	0.4	− .479	− 30	− .001	.00
1615....	− .232	0.8	− .494	− 29	− .007	− .02
1975....	− .339	0.7	+ .981	+209	+ .015	+ .03
2008....	− .365	0.9	+ .980	+220	− .002	− .01
2131....	− .530	1.0	− .415	+331	− .004	− .01
2136....	− .534	1.0	− .431	+332	− .007	− .02
2184....	−0.575	0.6	−0.934	+377	+0.015	+0.03

The normal equations are:

$9.1\,c-\ 0.461\mu+0.112\pi=$		-2.004
$100.596\ +2.648\ =$		-8.275
$5.534\ =$		$+0.023$

from which

$c=-0.225$

$\mu=-0.0846=-0″.225$ $\qquad \mu_a=-0″.055$

$\pi=+0.0492=+0″.131\pm0″.006$

Probable error corresponding to unit weight,

$\pm0.0050=\pm0″.013$

The parallax $+0″.210\pm0″.016$ has been obtained by Mr. Smith with the Yale heliometer.

58 ε Herculis (16^h56^m, $+31°4'$)

This bright star of magnitude 3.9 and type A has the following proper motion, according to Boss: $-0''.0036$ and $+0''.021$.

The star is a spectroscopic binary with a large range of velocities. The orbit has been investigated by Harper at Ottawa and by Baker at Allegheny. Baker derived the elements for both components, whose mass ratio he finds to be 1.6. The period is 4.0235 days and the velocity of the system is 21 km per second, approaching the sun. The parallax is based on twelve plates. They were measured by Mr. Lee.

TABLE 1

PLATES OF 58 ε HERCULIS

No.	Date	Hour Angle	Observers	Quality of Images
1554	1914 Apr. 9	$+0^h1$	Sl, L	Good
1559	Apr. 11	−0.6	Su, Sl	Good
1562	Apr. 12	−0.4	Su, Sl	Fair
1619	July 11	−0.4	Su, L	Good
1631	July 23	0.0	Su, L	Fair
1988	1915 Mar. 7	−0.5	Su, L	Fair*
2036	Mar. 28	−0.4	Su, L	Good
2067	Apr. 28	0.0	Su, L	Good
2151	July 11	−0.5	Su, L	Good
2156	July 15	+0.1	Su, L	Good
2157	July 17	−0.6	L	Good
2158	July 17	−0.2	L	Good

* One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.40	−168	− 95	+0.257
2	.32	−120	+ 11	.239
3	.34	− 33	−142	.214
4	.25	− 30	+221	.205
5	.29	+351	+ 5	+0.085
Parallax star	0.16	− 55.2	− 6.3	.....

The mean magnitude of the comparison stars is about 10.1. By means of the sector the parallax star was reduced about five magnitudes.

TABLE 2

REDUCTIONS FOR 58 ε HERCULIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\,v$ in Arc
1554	+0.013	1.0	+0.824	−260	−0.002	−0".01
1559	+ .028	1.0	+ .805	−258	+ .013	+ .03
1562	+ .015	0.7	+ .795	−257	.000	.00
1619	− .031	1.0	− .557	−167	− .010	− .03
1631	− .026	0.5	− .712	−155	− .001	.00
1988	+ .023	1.0	+ .987	+ 72	+ .014	+ .03
2036	.000	1.0	+ .919	+ 93	− .007	− .02
2067	− .013	1.0	+ .610	+124	− .012	− .03
2151	− .042	1.0	− .553	+198	− .010	− .03
2156	− .008	1.0	− .608	+202	+ .025	+ .07
2157	− .052	1.0	− .634	+204	− .018	− .05
2158	−0.019	1.0	−0.635	+204	+0.015	+0.04

The normal equations are:

$$10.9\,c + 0.876\mu + 0.723\pi = -0.120$$
$$41.496 - 6.892 = -0.305$$
$$5.619 = +0.148$$

from which

$$c = -0.012$$
$$\mu = -0.0031 = -0''.008 \qquad \mu_a = -0''.002$$
$$\pi = +0.0243 = +0''.065 \pm 0''.012$$

Probable error corresponding to unit weight,

$$\pm 0.0097 = \pm 0''.026$$

No other parallax is available for this star.

Anonymous (17^h34^m, $+18°36'$)

Slocum and Mitchell have called attention to this star in *Astrophysical Journal*, Vol. XXXVIII (1913), p. 12. It is conspicuous because of its redness and its absence from the *B.D. Catalogue*. The visual magnitude is about 9.1. It was found to have a large proper motion and parallax, and was therefore rejected as a comparison star for determining the parallax of B.D. 18°3424. On the plates taken for the latter star, the red star is about 13′ from the center. A new series was started in 1912, the red star being practically in the center of the plate. Only this second series of plates has been made use of in this new discussion.

The measures are by Mr. Van Biesbroeck.

TABLE 1

PLATES OF ANONYMOUS 17^h34^m

No.	Date	Hour Angle	Observers	Quality of Images
858	1912 Aug. 17	$+1^h8$	M	Fair*
1161	1913 Mar. 8	−1.3	Su, Sl	Fair
1178	Mar. 29	−0.6	Su, Sl	Fair
1183	Apr. 5	−0.9	Su, Sl	Good*
1192	Apr. 12	−0.8	Su, Sl	Good*
1196	Apr. 13	−0.5	Su, M	Fair
1317	July 20	−0.4	Su, M	Fair
1577	1914 May 3	+0.5	Su, Sl	Fair
2166	1915 July 25	+0.4	Su	Good*
2173	Aug. 8	+0.4	Su	Fair*
2178	Aug. 14	+0.7	Su	Good*
2185	Aug. 15	+1.1	Su	Poor*

* One exposure only.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.19	−166	+272	+0.206
2	.19	−125	− 82	.215
3	.25	− 92	−265	.219
4	.15	+168	−139	.189
5	.12	+215	+214	+0.171
Parallax star	0.29	− 12.6	− 9.5	.....

The mean magnitude of the comparison stars is approximately 10.3.

TABLE 2

REDUCTIONS FOR ANONYMOUS 17h34m

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
858....	−0.217	0.5	−0.882	−537	+0.006	+0".01
1161....	+ .074	0.7	+ .987	−334	+ .006	+ .01
1178....	+ .090	0.7	+ .964	−313	+ .004	+ .01
1183....	+ .108	0.7	+ .928	−306	+ .017	+ .04
1192....	+ .076	0.7	+ .878	−299	− .019	− .04
1196....	+ .080	0.7	+ .870	−298	− .016	− .04
1317....	+ .112	0.7	− .563	−200	− .003	− .01
1577....	+ .461	0.7	+ .661	+ 87	+ .009	+ .02
2166....	+ .810	0.7	− .625	+535	− .003	− .01
2173....	+ .821	0.5	− .792	+549	+ .004	+ .01
2178....	+ .826	0.7	− .850	+555	+ .006	+ .01
2185....	+0.802	0.3	−0.859	+556	−0.019	−0.03

The normal equations are:

$$\begin{aligned} 7.6\,c - 2.283\mu + 1.180\pi &= +2.389 \\ 117.386 - 15.751 &= +9.613 \\ 5.236 &= -0.835 \end{aligned}$$

from which

$$c = +0.335$$
$$\mu = +0.0954 = +0''.253 \qquad \mu_a = +0''.065$$
$$\pi = +0''.0519 = +0''.138 \pm 0''.010$$

Probable error corresponding to unit weight,

$$\pm 0.0065 = \pm 0''.017$$

The parallax determined by Mr. Slocum from 4 plates is:

$$\pi = +0''.108 \pm 0''.011$$

The proper motion in right ascension found at the same time was $\mu = +0''.931$. It is fully confirmed by the new series of measures. These have yielded at the same time the proper motion in declination,

$$\mu' = +0''.950 \text{ per year}$$

giving a total proper motion of 1".33.

Argelander-Oeltzen 17415–16 and B.D. 68°947 (17h37m, +68°26′)

The first star is B.D. 68°946 (9M1). From a comparison of 13 meridian observations taken about 20 years after his first observations in 1842, Argelander (*Bonner Beobachtungen*, Vol. VII [1869], p. 112) deduced the proper motion:

$$\mu = -0''.0679 \qquad \mu' = -1''.213$$

The star was observed in 1877 as A. G. Christiania 2710 and in 1897 as Greenwich Astrographic 68°6279. Assuming proper weights we find from these data:

$$\mu = -0''.0640 \qquad \mu' = -1''.279$$

The proper motion in right ascension corresponds to −0".352, making a total motion of 1".33.

Davidson (*Monthly Notices of the Royal Astronomical Society*, Vol. LXXV [1915], p. 597) gives the spectral type K and the photographic magnitude 9.8. According to *Greenwich Astrographic Catalogue*, Vol. III, the photographic magnitude is 10.3. The star is followed at 10 seconds in R.A. by the brighter star B.D. 68°947 (7M9) which does not partake of the large motion. This second star seems also to be of a different spectral type: the photographic magnitude, according to *Greenwich Astrographic Catalogue*, Vol. III (68°6280), is 8.0. The small difference between the visual and photographic brightness indicates an earlier type than K. This star has been used formerly in visual determinations of the parallax of the preceding one. Instead of using it as a comparison star, we have deduced its parallax from the same set of plates.

The measures are by Mr. Van Biesbroeck.

TABLE 1

PLATES OF A.OE. 17415–16 AND B.D. 68°947

No.	Date	Hour Angle	Observers	Quality of Images
716.....	1912 Mar. 21	−0h5	V, Sl	Good
750.....	Apr. 14	−0.6	Su, Sl	Fair
820.....	July 14	−0.4	Su, Sl	Fair
1162.....	1913 Mar. 8	−0.9	Su, Sl	Good
1170.....	Mar. 9	−1.2	Su, M	Poor
1195.....	Apr. 13	−1.2	Su, M	Fair
1630.....	1914 July 18	−0.2	Su, L	Good
1636.....	Aug. 1	−0.3	Su, L	Good
1641.....	Aug. 8	−0.3	Su, L	Good
1646.....	Aug. 9	−0.4	Su, L	Good
1649.....	Aug. 13	−0.1	Su, L	Fair
2068.....	1915 Apr. 28	−0.1	Su, L	Good
2074.....	May 1	−0.4	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence A	Dependence B
	mm				
1.....	0.42	− 81	+167	+0.21	+0.22
2.....	.21	−154	+225	.25	.26
3.....	.15	+207	−201	.11	.12
4.....	.12	+193	− 22	.06	.11
5.....	.11	−165	−169	+0.37	+0.29
Parallax star A	.19	− 83.0	+ 4.9	.....	.....
B	0.26	− 59.5	+ 20.4	.....	.....

Mean magnitude of the comparison stars is 9.2.

TABLE 2

REDUCTIONS FOR A.OE. 17415 AND B.D. 68°947

PLATE	SOLUTION (m) A	SOLUTION (m) B	WEIGHT (p)	PARALLAX FACTOR (P)	TIME IN DAYS (t)	$\sqrt{p}\cdot v$ IN ARC A.Oe. 17415	$\sqrt{p}\cdot v$ IN ARC B.D. 68°947
716..	+0.278	+0.019	1.0	+0.989	−602	−0″.02	+0″.02
750..	+ .269	+ .004	0.7	+ .866	−578	.01	− .02
820..	+ .123	+ .006	0.7	− .470	−487	.00	− .01
1162..	+ .161	+ .023	1.0	+ .986	−250	+ .01	+ .01
1170..	+ .158	+ .011	0.4	+ .986	−249	.00	− .01
1195..	+ .143	+ .019	0.7	+ .876	−214	+ .01	.00
1630..	− .132	+ .039	1.0	− .522	+247	+ .03	+ .05
1636..	− .152	+ .028	1.0	− .708	+261	+ .03	+ .02
1641..	− .174	+ .012	1.0	− .786	+268	− .01	− .02
1646..	− .181	+ .012	1.0	− .796	+269	− .02	− .02
1649..	− .181	+ .017	0.7	− .836	+273	− .01	− .01
2068..	− .130	+ .003	1.0	+ .734	+531	+ .03	− .06
2074..	−0.159	+0.045	1.0	+0.698	+534	−0.04	+0.05

The normal equations are:

	A.Oe. 17415	B.D. 68°947
$11.2\,c + 4.530\mu + 1.294\pi$	$= -0.753,$	$= +0.027$
$17.740 \quad -13.970$	$= +1.065,$	$= +0.022$
7.095	$= -0.179,$	$= +0.218$

from which

A.Oe. 17415–16

$c = -0.011$

$\mu = -0.0357 = -0″.095 \qquad \mu_a = -0^s.063$

$\pi = +0.0817 = +0″.217 \pm 0″.006$

B.D. 68°947

$c = +0.019$

$\mu = +0.0012 = +0″.032 \qquad \mu_a = +0^s.002$

$\pi = +0.0021 = +0″.005 \pm 0″.009$

Probable error corresponding to unit weight,

$\pm 0.0056 = \pm 0″.015 \qquad \pm 0.0086 = \pm 0″.023$

The former determinations of the parallax of A.Oe. 17415–16 are:

Parallax	Observer	Method
0″.247 ± 0″.021..	Krueger	Heliometer
0.111 ± 0.027..	Schweizer-Socoloff	Refractor, Position angles
0.191 ± 0.030..	Schweizer-Socoloff	Refractor, Distances
0.147 ± 0.020..	Schweizer-Socoloff	Refractor, Angles and distances
0.22 ± 0.050..	Flint	Meridian circle
0.35 ± 0.051..	Flint	Meridian circle
0.269 ± 0.012..	Davidson	Photography

Z Herculis (17^h54^m, +15°9′)

This star, which is B.D. 15°3311, was found to be a variable of the Algol type by Müller and Kempf in 1891. The period is nearly 4 days; the magnitude ranges from 7 to 8; the spectral type is F. According to the *A. G. Berlin A Catalogue* the proper motion is:

$\mu = -0^s.0009 \qquad \mu' = +0″.087$

By means of the rotating sector the apparent magnitude of the star was reduced by about two magnitudes.

The plates described in Table 1 were measured by Mr. Van Biesbroeck.

TABLE 1

PLATES OF Z HERCULIS

No.	Date	Hour Angle	Observers	Quality of Images
237.....	1910 Mar. 27	−0^h.9	Su, Sl	Fair
2055.....	1915 Apr. 24	+0.4	Su, J	Poor
2062.....	Apr. 25	+0.3	Su, L	Fair*
2069.....	Apr. 28	+0.2	Su, L	Poor
2072.....	Apr. 29	−0.1	Su, J	Fair
2078.....	May 5	−0.5	Su, L	Fair
2081.....	May 9	0.0	Su, J	Good
2191.....	Aug. 18	+0.4	Su	Fair
2199.....	Aug. 21	+0.6	Su	Fair
2214.....	Aug. 25	+0.6	Su	Good

* One exposure only.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.12	−352	−135	+0.164
2.....	.08	−319	+322	.177
3.....	.14	−181	+217	.174
4.....	.30	+208	−279	.158
5.....	.15	+299	− 22	.165
6.....	.26	+345	−103	+0.162
Parallax star...	0.24	− 7.6	+ 8.2	.....

The mean magnitude of the comparison stars is 10.5.

TABLE 2

REDUCTIONS FOR Z HERCULIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
237....	−0.011	0.7	+0.988	−1708	0.000	0″.00
2055....	.058	0.4	+ .820	+ 146	+ .003	.00
2062....	.064	0.5	+ .810	+ 147	− .003	− .01
2069....	.068	0.4	+ .779	+ 150	− .007	− .01
2072....	.052	0.7	+ .769	+ 151	+ .010	+ .02
2078....	.067	0.7	+ .700	+ 157	− .005	− .01
2081....	.064	1.0	+ .650	+ 161	− .001	.00
2191....	.062	0.7	− .842	+ 262	+ .019	+ .04
2199....	.080	0.7	− .869	+ 265	+ .002	.00
2214....	−0.096	1.0	−0.981	+ 269	−0.014	−0.04

The normal equations are:

$6.8\,c +$	$0.108\mu +$	$1.316\pi = -0.433$
229.912	-13.222	$= -0.742$
	4.539	$= -0.005$

from which

$$c = -0.066$$
$$\mu = -0.0026 = -0''.007 \qquad \mu_\alpha = -0^s.002$$
$$\pi = +0.0104 = +0''.028 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0.0060 = \pm 0''.016$$

No other determinations of parallax are available.

RX Herculis (18^h26^m, $+12°33'$)

The variablity of B.D. 12°3557 was discovered by Sawyer in 1898 (*Astronomical Journal*, Vol. XIX [1898], p. 144). The first investigations by Sawyer, Yendell, and Luizet indicated a period of about 0.89 days. Later photometric measures by Shapley and the discussion of Wendell's measures showed that there is a difference of nearly $0^M.1$ between the alternate minima, and that therefore the period is double the first amount (*Astrophysical Journal*, Vol. XL [1914], p. 399). From reasonable assumptions regarding the surface luminosity of this eclipsing system Shapley finds a hypothetical parallax of $\pi = 0''.006$. The limits of magnitude are 7.1 and 7.7. The spectral type is A.

By means of the rotating sector the apparent magnitude on the plate has been reduced by about 3 magnitudes.

The measures are by Mr. Van Biesbroeck.

TABLE 1

PLATES OF RX HERCULIS

No.	Date	Hour Angle	Observers	Quality of Images
273	1910 July 30	$+0^h.8$	Su, Sl	Poor
417	1911 May 6	−1.8	Su, Sl	Good
421	May 27	−1.4	Su	Poor*
1637	1914 Aug. 1	−0.4	Su, L	Good
1642	Aug. 8	−0.5	Su, L	Fair
2079	1915 May 5	−0.4	Su, L	Fair*
2080	May 5	0.0	Su, L	Fair*
2082	May 9	+0.3	Su, J	Good
2159	July 17	−0.6	L	Good
2174	Aug. 8	+0.2	Su	Fair
2179	Aug. 14	+0.4	Su	Good
2180	Aug. 14	+0.9	Su	Poor

* One exposure only.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.13	−334	+ 00	+0.136
2	.15	− 34	−203	.252
3	.13	+ 46	+122	.172
4	.20	+120	+ 25	.207
5	.12	+202	− 34	+0.233
Parallax star	0.13	+ 25.7	− 20.6	.....

The mean magnitude of the comparison stars is 10.1.

TABLE 2

REDUCTIONS FOR RX HERCULIS

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p.v}$ in Arc
273	−0.111	0.4	−0.522	−1339	+0.014	+0''.02
417	.144	1.0	+ .778	−1059	− .016	− .04
421	.084	0.3	+ .511	−1038	+ .043	+ .06
1637	.124	1.0	− .550	+ 124	− .008	− .02
1642	.125	0.7	− .646	+ 131	− .010	− .02
2079	.111	0.5	+ .787	+ 401	+ .008	+ .01
2080	.146	0.5	+ .787	+ 401	− .027	− .05
2082	.101	1.0	+ .743	+ 405	+ .018	+ .05
2159	.124	1.0	− .319	+ 474	− .010	− .03
2174	.086	0.7	− .642	+ 496	+ .027	+ .06
2179	.118	1.0	− .716	+ 502	− .006	− .01
2180	−0.110	0.4	−0.717	+ 502	+0.002	0.00

The normal equations are:

$$8.5\,c + 6.397\,\mu - 0.521\,\pi = -1.001$$
$$326.379 - 10.919 = -0.511$$
$$3.667 = +0.041$$

from which

$$c = -0.118$$
$$\mu = +0.0006 = +0''.002 \qquad \mu_\alpha = +0^s.000$$
$$\pi = -0.0037 = -0''.010 \pm 0''.016$$

Probable error corresponding to unit weight,

$$\pm 0.0109 = \pm 0''.029$$

β G.C. 8679 (18^h33^m, $-3°17'$)

This star, discovered by Aitken in 1901, is one of the most rapid visual binaries. The period is only 12.12 years according to *Lick Publications*, Vol. XII, p. 129. The major axis is given as $0''.176$. If the parallax deduced here is correct, the major axis would be 5.8 astronomical units in length and consequently the combined mass of the system 1.3 times the sun's mass. Aitken gives the magnitudes as 7.2 and 7.2. By means of the rotating sector the apparent magnitude has been reduced by about 3 magnitudes.

The nine plates described in Table 1 were measured by Mr. Van Biesbroeck.

TABLE 1

PLATES OF β G.C. 8679

No.	Date	Hour Angle	Observers	Quality of Images
399	1911 Apr. 8	$-1^h.5$	Su, Sl	Poor*
411	Apr. 22	−0.6	Su, Sl	Fair
479	Sept. 2	+0.1	Su, Sl	Poor
738	1912 Apr. 9	−1.2	V, Sl	Fair*
852	Aug. 11	+0.1	Su, Sl	Good
1343	1913 Aug. 21	−0.1	Su	Fair*
1347	Aug. 23	+0.1	Su	Good
1579	1914 May 13	−1.2	Su, Sl	Fair
1585	May 16	0.0	Su, Sl	Good

* One exposure.

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.10	−302	+131	+0.176
2.....	.12	−215	+ 23	.262
3.....	.08	+194	−179	.384
4.....	.24	+323	+ 25	+0.178
Parallax star...	0.13	+ 22.7	− 35.2	.....

The mean magnitude of the comparison stars is 10.1.

TABLE 2

REDUCTIONS FOR β G.C. 8679

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
399....	+0.067	0.3	+0.983	−558	−0.021	−0″.03
411....	.099	0.7	+ .915	−544	+ .012	+ .03
479....	.058	0.4	− .886	−411	− .006	− .01
738....	.079	0.5	+ .977	−191	− .004	− .01
852....	.064	1.0	− .667	− 67	+ .002	.00
1343....	.069	0.5	− .780	+308	+ .013	+ .02
1347....	.050	1.0	− .801	+310	− .006	− .02
1579....	.059	0.7	+ .715	+573	− .011	− .02
1585....	+0.076	1.0	+0.678	+576	+0.007	+0.02

The normal equations are:

$$\begin{aligned} 6.1\,c + \quad 5.660\,\mu + 0.390\,\pi &= +0.418 \\ 109.600 \quad -1.071 \quad &= +0.233 \\ 3.875 \quad &= +0.073 \end{aligned}$$

from which

$$c = +0.069$$
$$\mu = -0.0013 = -0''.004 \qquad \mu_\alpha = -0^s.000$$
$$\pi = +0.0114 = +0''.030 \pm 0''.008$$

Probable error corresponding to unit weight,

$$\pm 0.0062 = \pm 0''.016$$

2 ϵ Delphini (20^h28^m, $+10°58'$)

This fourth-magnitude star has only a very small proper motion. According to Boss's *Preliminary General Catalogue:*

$$\mu = +0^s.0006 \qquad \mu' = -0''.026$$

The spectral type is B 5.

The measures are by Mr. Van Biesbroeck.

TABLE 1

PLATES OF 2 ϵ DELPHINI

No.	Date	Hour Angle	Observers	Quality of Images
1673.....	1914 Sept. 3	−0h2	Su, L	Fair
1727.....	Oct. 21	−0.1	J	Good
1734.....	Oct. 22	−0.2	L	Good
2096.....	1915 May 30	−0.3	Su, J	Poor
2107.....	June 13	−0.4	Su, J	Fair
2112.....	June 16	−0.2	Su, L	Fair
2113.....	June 16	+0.1	Su, L	Poor
2175.....	Aug. 8	−1.3	Su	Good
2201.....	Aug. 21	−0.8	Su	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1.....	0.12	−115	+196	+0.135
2.....	.24	−115	−134	.144
3.....	.23	− 45	−152	.181
4.....	.19	+ 98	−207	.257
5.....	.12	+177	+297	+0.283
Parallax star...	0.27	+ 35.0	+ 10.3	.....

The mean magnitude of the comparison stars is 10.5. The sector was used.

TABLE 2

REDUCTIONS FOR 2 ϵ DELPHINI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
1673....	−0.090	0.7	−0.573	−212	−0.008	−0″.02
1727....	.078	1.0	− .958	−164	+ .008	+ .02
1734....	.088	1.0	− .960	−163	− .002	.00
2096....	.062	0.4	+ .817	+ 57	+ .012	+ .02
2107....	.066	0.7	+ .669	+ 71	+ .010	+ .02
2112....	.079	0.7	+ .632	+ 74	− .003	− .01
2113....	.094	0.4	+ .632	+ 74	− .018	− .03
2175....	.090	1.0	− .180	+127	− .008	− .02
2201....	−0.079	1.0	−0.384	+140	+0.005	+0.01

The normal equations are:

$$\begin{aligned} 6.9\,c - \quad 0.545\,\mu - 1.393\,\pi &= -0.562 \\ 13.151 \quad +4.253 \quad &= +0.064 \\ 3.269 \quad &= +0.132 \end{aligned}$$

from which

$$c = -0.080$$
$$\mu = -0.0008 = -0''.002 \qquad \mu_\alpha = -0^s.000$$
$$\pi = +0.0073 = +0''.020 \pm 0''.012$$

Probable error corresponding to unit weight,

$$\pm 0.0058 = \pm 0''.016$$

Among the plates obtained by Schlesinger in 1904 there are four of this field that were taken under the same conditions as the present series. A comparison with the recent plates by means of the blink-comparator having shown that none of the comparison stars has an appreciable motion after an 11 years' interval of time, a second solution was made, adopting the proper motion as given by Boss. We then find: $\pi = +0''.013 \pm 0''.008$ with a probable error of $\pm 0''.015$ corresponding to unit weight.

10 κ Pegasi (21^h40^m, $+25°11'$)

This is the brighter star of a wide pair found by Herschel in 1786, which was first measured by Struve in 1831. There seems to be a discrepancy in the relative motion of the two components. A brief discussion is given by Burnham, in *Publications of the Yerkes Observatory*, Vol. I (1900), p. 236, of the possible explanations. In 1880 Burnham found the bright star to be a very close double, the magnitude

of the components being 4.8 and 5.3, and their distance 0".2± only. The combined spectrum is F5. According to Campbell (*Astrophysical Journal*, Vol. XII [1900], p. 256) one of the components of this double is a spectroscopic binary with a range (tentative) of 80 km and a period of about .6 days.

The distant companion is cut off entirely from our plates by the rotating sector, so that the fourteen plates described in Table 1 refer to the close double alone. The two components are, of course, seen as one round image on the plates. The measures were made by Mr. Lee.

TABLE 1

PLATES OF 10 κ PEGASI

No.	Date	Hour Angle	Observers	Quality of Images
968	1912 Oct. 27	+0^h.4	Su, Sl	Good
1393	1913 Oct. 5	−0.4	Su, Sl	Fair
1431	Nov. 16	+0.1	Sl	Fair
1440	Nov. 23	+0.1	Sl	Poor
1608	1914 July 1	+0.1	Su, L	Fair
1617	July 8	0.0	Su, L	Poor
1625	July 15	+0.2	Su, L	Poor
1694	Oct. 1	+0.1	Su, L	Poor
1715	Oct. 17	−0.1	Su, J	Poor
1729	Oct. 21	0.0	Su, J	Good
1736	Oct. 22	+0.1	L, J	Fair
2125	1915 June 26	0.0	Su, L	Good
2142	July 4	+0.2	Su, L	Fair
2143	July 4	+0.6	Su, L	Good

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.32	−409	+116	+0.191
2	.29	−310	− 83	.142
3	.28	−234	+164	.192
4	.14	+ 21	−184	.101
5	.14	+246	+ 46	.139
6	.18	+341	+ 2	.125
7	.63	+345	− 61	+0.110
Parallax star	0.35	− 49.9	+ 23.1	

The mean magnitude of the comparison stars is 9.8. The sector was used.

TABLE 2

REDUCTIONS FOR 10 κ PEGASI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\cdot v$ in Arc
968	+0.270	1.0	−0.890	−627	−0.003	−0".01
1393	.270	0.7	− .717	−284	− .010	− .02
1431	.292	0.7	− .934	−242	+ .014	+ .03
1440	.290	0.4	− .923	−235	+ .011	+ .02
1608	.295	0.7	+ .658	− 15	.000	.00
1617	.288	0.4	+ .572	− 8	− .006	− .01
1625	.304	0.4	+ .479	− 1	+ .011	+ .02
1694	.306	0.4	− .672	+ 77	+ .021	+ .03
1715	.262	0.4	− .824	+ 93	− .022	− .04
1729	.286	1.0	− .852	+ 97	+ .002	+ .01
1736	.271	0.5	− .859	+ 98	− .013	− .02
2125	.286	1.0	+ .716	+345	− .014	− .04
2142	.310	0.7	+ .625	+353	+ .010	+ .02
2143	+0.306	1.0	+0.625	+353	+0.006	+0.02

The normal equations are:

$$9.3\,c + 0.558\mu - 1.635\pi = +2.680$$
$$86.376 + 13.826 = +0.396$$
$$5.353 = -0.411$$

from which

$$c = +0.290$$
$$\mu = +0.0014 = +0".004 \qquad \mu_a = +0^s.001$$
$$\pi = +0.0080 = +0".021 \pm 0".011$$

Probable error corresponding to unit weight,

$$\pm 0.0067 = \pm 0".018$$

The luminosities of the two components of this star are 19.1 and 12.0 in terms of the sun's total light. The system is 6.9 times as massive as the sun.

The radial velocity of the system is not known, but its cross motion is 6.2 km per second.

22 λ Cephei (22^h8^m, +58°55′)

At the Harvard College Observatory this star has been classified as having a spectrum of type Od, similar to that of ζ Puppis. The magnitude, according to the *Revised Harvard Photometry*, is 5.2. In the *Potsdamer Durchmusterung* the magnitude is given as 5.3 and the color as yellowish-white.

Boss gives for the annual proper motions:

$$\mu = +0^s.0029 \qquad \mu' = -0".006$$

The plates were measured by Mr. Van Biesbroeck.

TABLE 1

PLATES OF 22 λ CEPHEI

No.	Date	Hour Angle	Observers	Quality of Images
985	1912 Nov. 10	−0^h.3	M, Sl	Fair
986	Nov. 10	+0.1	M, Sl	Good
996	Nov. 16	0.0	M, Sl	Good
1278	1913 June 26	−0.3	Su, Sl	Good
1288	June 29	−0.2	Su	Poor
1722	1914 Oct. 18	−0.4	Su, J	Good
1730	Oct. 21	0.0	Su, J	Good
1757	Oct. 25	+0.1	Su, J	Good
2147	1915 July 8	−0.6	Su	Good
2148	July 8	−0.1	Su, L	Good
2277	Oct. 9	−0.3	Su, L	Fair

COMPARISON STARS

No.	Diameter	X (Right Ascension)	Y (Declination)	Dependence
	mm			
1	0.18	−272	+237	+0.203
2	.34	−236	−235	.200
3	.15	+111	+296	.201
4	.17	+139	−202	.198
5	.26	+258	− 96	+0.198
Parallax star	0.20	− 1.1	+ 1.6	

The mean magnitude of the comparison stars is 9.6.

The rotating sector was used for the parallax star.

TABLE 2

REDUCTIONS FOR 22 λ CEPHEI

Plate	Solution (m)	Weight (p)	Parallax Factor (P)	Time in Days (t)	Residual (v)	$\sqrt{p}\,v$ in Arc
985....	+0.392	0.7	−0.907	−509	+0.020	+0″.04
986....	.372	1.0	− .907	−509	.000	.00
996....	.363	1.0	− .921	−503	− .010	− .03
1278....	.356	1.0	+ .779	−281	− .002	− .01
1288....	.358	0.4	+ .751	−278	.000	.00
1722....	.364	1.0	− .762	+198	− .002	− .01
1730....	.360	1.0	− .788	+201	− .006	− .02
1757....	.370	1.0	− .820	+205	+ .004	+ .01
2147....	.354	1.0	+ .661	+461	+ .001	.00
2148....	.356	1.0	+ .661	+461	+ .003	+ .01
2277....	+0.364	0.7	−0.668	+554	+0.002	0.00

The normal equations are:

$$9.8\,c + 1.533\,\mu - 2.899\,\pi = +3.567$$
$$156.483 + 8.187 = +0.373$$
$$6.139 = -1.101$$

from which

$$c = +0.362$$
$$\mu = -0.0008 = -0''.002 \qquad \mu_\alpha = -0^s.001$$
$$\pi = -0.0074 = -0''.020 \pm 0''.006$$

Probable error corresponding to unit weight,

$$\pm 0.0049 = \pm 0''.013$$

After two additional morning plates had been obtained, this series of plates was remeasured here by Mr. Everett I. Yowell, of the Cincinnati Observatory, with the following results:

$$\mu_\alpha = +0^s.000$$
$$\pi = -0''.013 \pm 0''.009$$

Probable error corresponding to unit weight,

$$\pm 0''.018$$

SUMMARY OF RESULTS FOR 26 STARS (LEE AND VAN BIESBROECK)

Star	R.A. 1900	Decl. 1900	*B.D.* Number	Magnitude and Spectrum	Proper Motion	Relative Parallax	Probable Error	No. of Plates	Probable Error of One Plate	No. of Comp. Stars
6 Persei	2h 7m	+50° 36′	+50°481	5.4, G5	0″.4	−0″.006	±0″.010	15	±0″.026	5
β G.C. 2745 A	5 23	+54 35	+54 902	7.5	0.43	+ .023	.008	12	.019	5
B				9.2	0.43	+ .013	.005	12	.013	5
A.Oe. 7846	7 18	+46 18	+46 1264	8.9	0.36	+ .016	.005	12	.012	5
75 σ Geminorum	7 37	+29 8	+29 1590	4.3, K	0.25	+ .019	.013	11	.027	4
W Ursae Majoris	9 37	+56 25	+56 1400	Var., G		+ .008	.010	14	.020	5
Lalande 22667	11 59	+ 3 55	+ 4 2568	9	0.55	+ .011	.014	12	.028	5
A.Oe. 14318	15 5	−15 59	−15 4041	9.6, G5	3.69	+ .026	.008	10	.015	6
A.Oe. 14320	15 5	−15 54	−15 4042	9.2, G4	3.67	+ .061	.012	10	.025	6
13 δ Serpentis A	15 30	+10 53	+11 2821	4.2, A5	0.01	+ .004	.011	10	.023	4
B				5.2	0.01	+ .012	.004	10	.010	4
ξ Scorpii A and B	15 59	−11 6	−10 4237	4.8, F8	0.10	+ .049	.009	11	.020	5
C				5.1	0.10	+ .061	.006	11	.013	5
7 κ Herculis A	16 4	+17 19	+17 2964	5.3, K	0.02	− .009	.008	12	.020	3
B			+17 2965	6.5	0.04	− .026	.008	12	.020	3
W.B. I, 16h906	16 50	− 8 9	− 8 4352	8.8, Mb	1.27	+ .131	.006	11	.013	6
58 ε Herculis	16 56	+31 4	+31 2947	3.9, A	0.03	+ .065	.012	12	.026	5
Anonymous	17 34	+18 36		9.1	1.33	+ .138	.010	12	.017	5
A.Oc. 17415–16	17 37	+68 26	+68 946	9.1, K	1.33	+ .217	.006	13	.015	5
B.D. +68°947			+68 947	8		+ .005	.009	13	.023	5
Z Herculis	17 54	+15 9	+15 3311	Var., F	0.09	+ .028	.010	10	.016	6
RX Herculis	18 26	+12 33	+12 3557	Var., A		− .010	.016	12	.029	5
β G.C. 8679	18 33	− 3 17	− 3 4331	7		+ .030	.008	9	.016	4
2 ε Delphini	20 28	+10 58	+10 4321	4.0, B5	0.03	+ .013	.008	9	.015	5
10 κ Pegasi	21 40	+25 11	+24 4463	4.3, F5	0.03	+ .021	.011	14	.018	7
22 λ Cephei	22 8	+58 55	+58 2402	5.3, O		−0.020	±0.006	11	±0.013	5

SUMMARY OF RESULTS FOR 28 STARS (SCHLESINGER)*

Star	R.A. 1900	Decl. 1900	*B.D.* Number	Magnitude and Spectrum	Proper Motion	Relative Parallax	Probable Error	Co-ord.	No. of Plates	Probable Error of One Plate
Groombridge 34	$0^h\,13^m$	+43° 27′	+43° 44	8.2, Ma	2″.85	+0″.256	±0″.019	long.	12	±0″.040
Groombridge 34 (Companion)	.....	.....	.....	10, –	.....	+ .269	.011	long.	10	.019
					Mean	+ **.266**	**.010**			
μ Cassiopeiae	1 2	+54 26	+54 223	5.3, G5	3.75	+ **.105**	**.010**	long.	9	.019
Lalande 5761	3 3	+25 58	+25 495	8.0, F2	0.90	+ **.010**	**.020**	long.	10	.046
Lalande 7443	3 56	+35 3	+34 796	8.6, G2	2.19	+ **.039**	**.013**	long.	11	.025
c Persei	4 1	+47 27	+47 939	4.0, B3	0.05	+ **.008**	**.009**	long.	8	.016
π^4 Orionis	4 46	+ 5 26	+ 5 745	3.8, B3	0.01	– **.012**	**.007**	long.	11	.014
ϕ Orionis	5 22	+ 3 1	+ 2 962	4.7, B2	0.01	– **.019**	**.015**	long.	14	.029
Weisse I, 5^h592	5 26	– 3 42	– 3 1123	8.9, Ma	2.23	+ **.189**	**.010**	long.	18	.027
S Monocerotis	6 35	+ 9 59	+10 1220	4.7, Oe5	0.01	– **.007**	**.012**	long.	8	.022
Lalande 13427	6 54	+48 32	+48 1469	8.2, –	0.71	+ **.049**	**.011**	long.	10	.022
Lalande 15290	7 47	+30 55	+31 1684	8.2, G0	1.97	+ **.072**	**.019**	long.	14	.042
Fedorenko 1457	9 8	+53 7	+53 1320	7.9, Ma		+ .172	.025	R.A.	12	.044
Fedorenko 1457	.....	.....	.....	.....	1.69	+ .145	.036	decl.	12	.027
Fedorenko 1458	.....	.....	+53 1321	7.9, Ma		+ .149	.028	R.A.	12	.050
Fedorenko 1458	.....	.....	.....	.....	.....	+ .112	.032	decl.	12	.025
					Mean	+ **.148**	**.015**			
Lalande 23917	12 45	+ 1 45	+ 2 2585	8.3, –	0.68	+ .035	.020	R.A.	13	.028
						– .025	.044	decl.	13	.029
					Mean	+ **.025**	**.018**			
Berlin A 4999	13 40	+18 24	+18 2776	9.6, G5	1.92	+ **.077**	**.014**	long.	11	.020
Lalande 25372	13 41	+15 26	+15 2620	8.7, K5	2.33	+ **.152**	**.007**	long.	11	.012
Fedorenko 2544	14 52	+54 4	+54 1716	7.9, G	1.08	+ .056	.019	R.A.	12	.027
						+ .028	.025	decl.	12	.022
					Mean	+ **.046**	**.015**			
Weisse I, 17^h322	17 21	+ 2 14	+ 2 3312	7.8, Ma	1.36	+ **.14**	**.020**	long.	16	.032
P.M. 2164 (prec.)	18 42	+59 29	+59 1915	8.8, K	2.28	+ .281	.004	R.A.	23	.014
P.M. 2164 (prec.)	.....	.....	.....	.....	.....	+ .286	.012	decl.	22	.013
P.M. 2164 (fol.)	.....	.....	.....	9.3, –	.....	+ .280	.006	R.A.	23	.019
P.M. 2164 (fol.)	.....	.....	.....	.....	.....	+ .314	.019	decl.	22	.020
					Mean	+ **.282**	**.003**			
Lamont 18180	18 53	+ 5 48	+ 5 3993	9.4, Ma	1.24	+ **.06**	**.012**	long.	21	.027
Lamont 18816	19 2	+ 7 29	+ 7 3967	9.3, –	0.80	+ **.036**	**.007**	long.	11	.010
31 b Aquilae	19 20	+11 44	+11 3833	5.2, G5	0.96	+ **.101**	**.022**	long.	10	.021
Lalande 39866	20 35	+ 4 37	+ 4 4510	8.4, K	0.86	+ **.067**	**.022**	long.	14	.033
Groombridge 3689	22 3	+52 39	+52 3112	8.1, –	0.61	+ .018	.014	R.A.	16	.031
						+ .080	.018	decl.	16	.021
					Mean	+ **.041**	**.020**			
Krüger 60	22 24	+57 12	+56 2783	9.2, K5	0.92	+ .257	.007	R.A.	19	.018
						+ .238	.011	decl.	19	.014
					Mean	+ **.252**	**.006**			
Lalande 46650	23 44	+ 1 52	+ 1 4774	8.9, Ma	1.40	+ .161	.014	R.A.	13	.021
						+ .095	.033	decl.	12	±0.022
					Mean	**+0.151**	**±0.013**			

*From the *Astrophysical Journal*, Vol. XXXIV (1911), pp. 28–29.

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REFERRED TO IN THIS PART AND IN PRIOR PUBLICATIONS

Star	R.A. 1900	Decl. 1900	Measured By	For Full Data See	For Summary See This Volume, Page
0Σ 547 A	$0^h\ 0^m$	+45° 16′	Slocum	This volume, p. 5	27
B	0 0	+45 16	Slocum	*Ibid.*, p. 5	27
C	0 0	+45 14	Slocum	*Ibid.*, p. 5	27
Groombridge 34	0 13	+43 27	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 173	58
Companion	0 13	+43 27	Schlesinger	*Ibid.*, p. 175	58
30 ϵ Andromedae	0 33	+28 46	Slocum	This volume, p. 6	27
37 μ Andromedae	0 51	+37 57	Slocum	*Ibid.*, p. 7	27
30 μ Cassiopelae	1 2	+54 26	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 177	58
Lalande 1966	1 3	+61 1	Mitchell	This volume, p. 7	27
42 ϕ Andromedae	1 4	+46 43	Slocum	*Ap.J.*, Vol. XXXVIII (1913), p. 2	27
48 Cassiopelae	1 54	+70 25	Slocum	*Ap.J.*, Vol. XXXVIII (1913), p. 4	27
6 Persei	2 7	+50 36	Van Biesbrocck	This volume, p. 43	57
B.D. +48°739	2 36	+48 34	Slocum	*Ibid.*, p. 8	27
13 θ Persei	2 37	+48 48	Slocum	*Ibid.*, p. 9	27
Companion	2 37	+48 48	Slocum	*Ibid.*, p. 9	27
20 Persei	2 47	+37 56	Mitchell	*Ap.J.*, Vol. XXXVIII (1913), p. 6	27
26 β Persei	3 2	+40 34	Lee	This volume, p. 31	40
Lalande 5761	3 3	+25 58	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 179	58
33 α Persei	3 17	+49 30	Slocum	This volume, p. 10	27
Lalande 6888	3 40	+41 9	Mitchell	*Ibid.*, p. 10	27
Lalande 6889	3 40	+41 9	Mitchell	This volume, p. 10	27
Companion to Lal. 6888–9	3 40	+41 9	Mitchell	*Ibid.*, p. 10	27
46 ξ Persei	3 52	+35 30	Slocum	*Ibid.*, p. 11	27
Lalande 7443	3 56	+35 3	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 181	58
c Persei	4 01	+47 27	Schlesinger	*Ibid.*, p. 182	58
A.Oe. 4961	4 30	+52 42	Slocum	This volume, p. 12	27
9 Camelopardalis	4 44	+66 10	Mitchell	*Ap.J.*, Vol. XXXVIII (1913), p. 7	27
7 π^4 Orionis	4 46	+ 5 26	Schlesinger	*Ibid.*, Vol. XXXIII (1911), p. 234	58
25 ψ Orionis	5 22	+ 3 1	Schlesinger	*Ibid.*, p. 235	58
β G.C. 2745 A	5 23	+54 35	Van Biesbrocck	This volume, p. 44	57
β G.C. 2745 B	5 23	+54 35	Van Biesbrocck	This volume, p. 44	57
Weisse I, 5^h592	5 26	− 3 42	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 237	58
37 ϕ^1 Orionis	5 29	+ 9 25	Slocum	This volume, p. 13	27
Trapezium in Orion A	5 30	− 5 27	Slocum	*Ibid.*, p. 14	27
B	5 30	− 5 27	Slocum	*Ibid.*, p. 14	27
Trapezium in Orion C	5 30	− 5 27	Slocum	This volume, p. 14	27
D	5 30	− 5 27	Slocum	*Ibid.*, p. 14	27
40 ϕ^2 Orionis	5 31	+ 9 14	Mitchell	*Ibid.*, p. 13	27
61 μ Orionis	5 57	+ 9 39	Mitchell	*Ap.J.*, Vol. XXXVIII (1913), p. 9	27
S Monocerotis	6 35	+ 9 59	Schlesinger	*Ibid.*, Vol. XXXIII (1911), p. 240	58
Nova Geminorum 2	6 48	+32 15	Slocum	*M.N.*, Vol. LXXIII (1913), p. 437	27
14 θ Canis Majoris	6 49	−11 55	Joy	This volume, p. 32	40
Lalande 13427	6 54	+48 32	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 242	58
A.Oe. 7846	7 18	+46 18	Van Biesbrocck	This volume, p. 44	57
75 σ Geminorum	7 37	+29 8	Van Biesbrocck	*Ibid.*, p. 45	57
Lalande 15290	7 47	+30 55	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 243	58
Lalande 15565	7 54	+29 31	Joy	This volume, p. 32	40
Weisse II, 8^h596	8 29	+42 6	Mitchell	*Ibid.*, p. 16	27
D'Agelet 1623	8 49	+26 35	Lee	*Ibid.*, p. 33	40
Fedorenko 1457	9 8	+53 7	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 245	58
Fedorenko 1458	9 8	+53 7	Schlesinger	*Ap. J.*, Vol. XXXIII (1911), p. 245	58
W Ursae Majoris	9 37	+56 25	Lee	This volume, p. 46	57
A.Oe. 10640	10 7	+53 1	Joy	*Ibid.*, p. 33	40
Lalande 23223	10 20	− 3 44	Lee	*Ibid.*, p. 34	40
Anonymous	11 6	+ 6 59	Slocum	*Ibid.*, p. 16	27
Lalande 22667	11 59	+ 3 55	Lee	This volume, p. 46	57
Anonymous	12 17	+25 44	Slocum	*Ibid.*, p. 17	27
Lalande 23917	12 45	+ 1 45	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 255	58
42 Comae Berenices	13 5	+18 3	Slocum	*Ibid.*, Vol. XLI (1915), p. 237	27
B.D. +18°2696	13 5	+18 1	Slocum	This volume, p. 17	27
Berlin A 4999	13 40	+18 24	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 258	58
Lalande 25372	13 41	+15 26	Schlesinger	*Ibid.*, p. 353	58
A.G. Berlin B 5072	14 21	+24 6	Lee	This volume, p. 34	40
A.G. Berlin B 5073	14 21	+24 6	Lee	*Ibid.*, p. 34	40
Fedorenko 2544	14 52	+54 4	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 354	58
A.Oe. 14318	15 5	−15 59	Lee	This volume, p. 47	57
A.Oe. 14320	15 5	−15 54	Lee	*Ibid.*, p. 47	57
Lalande 27744	15 9	− 1 00	Lee	*Ibid.*, p. 35	40
2 η Coronae Borealis	15 19	+30 39	Slocum	*Ap.J.*, Vol. XLI (1915), p. 239	27
13 δ Serpentis A	15 30	+10 53	Lee	This volume, p. 48	57

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Star	R.A. 1900	Decl. 1900	Measured By	For Full Data See	For Summary See This Volume, Page
13 δ Serpentis B	15h 30m	+10° 53′	Lee	This volume, p. 48	57
51 ξ Scorpii A and B	15 59	−11 6	Lee	*Ibid.*, p. 48	57
C			Lee	*Ibid.*, p. 48	57
Oxford +25°46092	16 0	+25 30	Slocum	*Ibid.*, p. 18	27
7 κ Herculis A	16 4	+17 19	Lee	*Ibid.*, p. 49	57
7 κ Herculis B	16 4	+17 19	Lee	This volume, p. 49	57
Groningen VII. No. 20	16 21	+48 35	Slocum	*Ap.J.*, Vol. XXXVIII (1913), p. 1	27
10 λ Ophiuchi	16 26	+ 2 12	Lee	This volume, p. 36	40
W.B. I. 16h906	16 50	− 8 9	Miss J. M. Hawkes	*Ibid.*, p. 50	57
58 ε Herculis	16 56	+31 4	Lee	*Ibid.*, p. 51	57
B.D. +42°2810	17 10	+42 28	Slocum	This volume, p. 18	27
U Ophiuchi	17 14	+ 1 18	Joy	*Ibid.*, p. 37	40
Weisse I, 17h322	17 21	+ 2 14	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 358	58
Anonymous	17 34	+18 36	Slocum	*Ibid.*, Vol. XXXVIII (1913), p. 12	27
Anonymous	17 34	+18 36	Van Biesbroeck	This volume, p. 51	57
B.D. +18°3423	17 34	+18 37	Slocum	*Ap.J.*, Vol. XXXVIII (1913), p. 12	27
B.D. +18°3424	17 34	+18 37	Miss M. M. Hopkins	*Ibid.*, p. 12	27
A.Oe. 17415–16	17 37	+68 26	Van Biesbroeck	This volume, p. 52	57
B.D. 68°947	17 37	+68 26	Van Biesbroeck	*Ibid.*, p. 52	57
Z Herculis	17 54	+15 9	Van Biesbroeck	*Ibid.*, p. 53	57
96 Herculis	17 58	+20 50	Mitchell	*Ap.J.*, Vol. XXXVIII (1913), p. 16	27
70 Ophiuchi	18 0	+ 2 31	Slocum	*Ibid.*, Vol. XLI (1915), p. 240	27
RX Herculis	18 26	+12 33	Van Biesbroeck	This volume, p. 54	57
β G.C. 8679	18 33	− 3 17	Van Biesbroeck	*Ibid.*, p. 54	57
4 e^1 Lyrae pr	18 41	+39 34	Mitchell	*Ibid.*, p. 19	27
4 e^1 Lyrae fol	18 41	+39 34	Mitchell	This volume, p. 19	27
5 e^2 Lyrae pr	18 41	+39 30	Mitchell	*Ibid.*, p. 19	27
5 e^2 Lyrae fol	18 41	+39 30	Mitchell	*Ibid.*, p. 19	27
P.M. 2164 pr	18 42	+59 29	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 360	58
P.M. 2164 fol	18 42	+59 29	Schlesinger	*Ibid.*, p. 360	58
Draconis 205	18 45	+49 19	Joy	This volume, p. 37	40
Lamont 18180	18 53	+ 5 48	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 369	58
B.D. +18°3911	18 56	+18 57	Slocum	This volume, p. 20	27
Lamont 18816	19 2	+ 7 29	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 371	58
17 Lyrae C	19 4	+32 21	Slocum	*Ibid.*, Vol. XXXVIII (1913), p. 18	27
31 b Aquilae	19 20	+11 44	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 372	58
16 Cygni pr	19 39	+50 18	Mitchell	This volume, p. 21	27
16 Cygni fol	19 39	+50 17	Mitchell	*Ibid.*, p. 21	27
β G.C. 9919 A	20 2	+35 30	Lee	*Ibid.*, p. 38	40
β G.C. 9919 D	20 2	+35 30	Lee	*Ibid.*, p. 38	40
P Cygni	20 14	+37 43	Mitchell	*Ap.J.*, Vol. XXXVIII (1913), p. 19	27
B.D. +43°3571	20 17	+43 34	Joy	This volume, p. 38	40
2 ε Delphini	20 28	+10 58	Van Biesbroeck	*Ibid.*, p. 55	57
Lalande 39866	20 35	+ 4 37	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 418	58
3 η Cephei	20 43	+61 27	Slocum	This volume, p. 22	27
Y Cygni	20 48	+34 17	Mitchell	This volume, p. 23	27
61_1 Cygni	21 2	+38 15	Slocum	*Ibid.*, p. 23	27
61_2 Cygni	21 2	+38 15	Slocum	*Ibid.*, p. 23	27
65 τ Cygni	21 10	+37 37	Mitchell	*Ap.J.*, Vol. XXXVIII (1913), p. 21	27
8 β Cephei	21 27	+70 7	Lee	This volume, p. 39	40
10 κ Pegasi	21 40	+25 11	Lee	This volume, p. 55	57
Groombridge 3689	22 3	+52 39	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 420	58
22 λ Cephei	22 8	+58 55	Van Biesbroeck*	This volume, p. 56	57
23 ε Cephei	22 11	+56 33	Mitchell	*Ibid.*, p. 24	27
Krüger 60	22 24	+57 12	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 423	58
Nova Lacertae	22 32	+52 12	Slocum	*Ap.J.*, Vol. XXXVIII (1913), p. 23	27
B.D. +29°4753	22 41	+29 54	Lee	This volume, p. 40	40
B.D. +28°4562	23 15	+28 19	Slocum	*Ibid.*, p. 25	27
Oxford +29°08304	23 21	+28 39	Slocum	*Ibid.*, p. 25	27
35 γ Cephei	23 35	+77 4	Mitchell	*Ibid.*, p. 26	27
Lalande 46650	23 44	+ 1 52	Schlesinger	*Ap.J.*, Vol. XXXIII (1911), p. 427	58
85 Pegasi	23 56	+26 34	Slocum	*Ibid.*, Vol. XLI (1915), p. 242	27

* And E. I. Yowell.

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APPENDIX

APPENDIX

INVESTIGATION OF A NEW SCREW MEASURING MACHINE AT THE YERKES OBSERVATORY

By Oliver J. Lee and Hannah B. Steele

The machine which is shown in the accompanying plate is one of several machines of this type that have recently been completed by William Gaertner & Co., of Chicago, for various observatories in this country. A brief account of the qualities of the machine as shown by the definitive tests was published in the *Astronomical Journal*, Vol. XXX, 1917, p. 128. The addition of this instrument to the available equipment of the Observatory was made possible by the grant of $640 to Mr. Frost by the directors of the Gould Fund of the National Academy of Sciences.

The machine has a screw 18 mm in diameter, with 249 threads of millimeter pitch. The half-split nut is 50 mm wide. The screw-head is a wheel 18 cm in diameter, graduated to the unit 0.001 mm. The screw also carries a gear-wheel into which may be meshed at will a large auxiliary wheel mounted beside it. This wheel is provided with a crank and gives a fast motion for the screw of the ratio five to one. Smooth depressions in the fiber wheels at the end of the screw and the ends of the rachet shaft of the plate-carriage enable the observer to "spin" them easily with a finger.

The plate-carriage is moved by a rack and pinion operated from either side and is guided by the usual form of V-way on one side and a plane support on the other. It has an opening 17.5×19 cm ($7 \times 7\frac{1}{2}$ inches), but the constant-plane plate-clamps have been arranged so as to accommodate plates up to 20×25 cm (8×10 inches) in size. The machine-bed is supported at an angle of 45° with the horizontal. Daylight illumination is reflected into the field of the microscope from a long mirror supported under a slit 33 mm wide, cut across the bed. The plate-carriage has a graduated position-circle provided with a pinion and a vernier reading to the tenth of a degree directly and the hundredth by estimation.

The miscroscope system has a variable magnification ranging from 8.5 to 17 diameters. For all our testing work an auxiliary eyepiece and reticle were used, giving about 75 diameters.

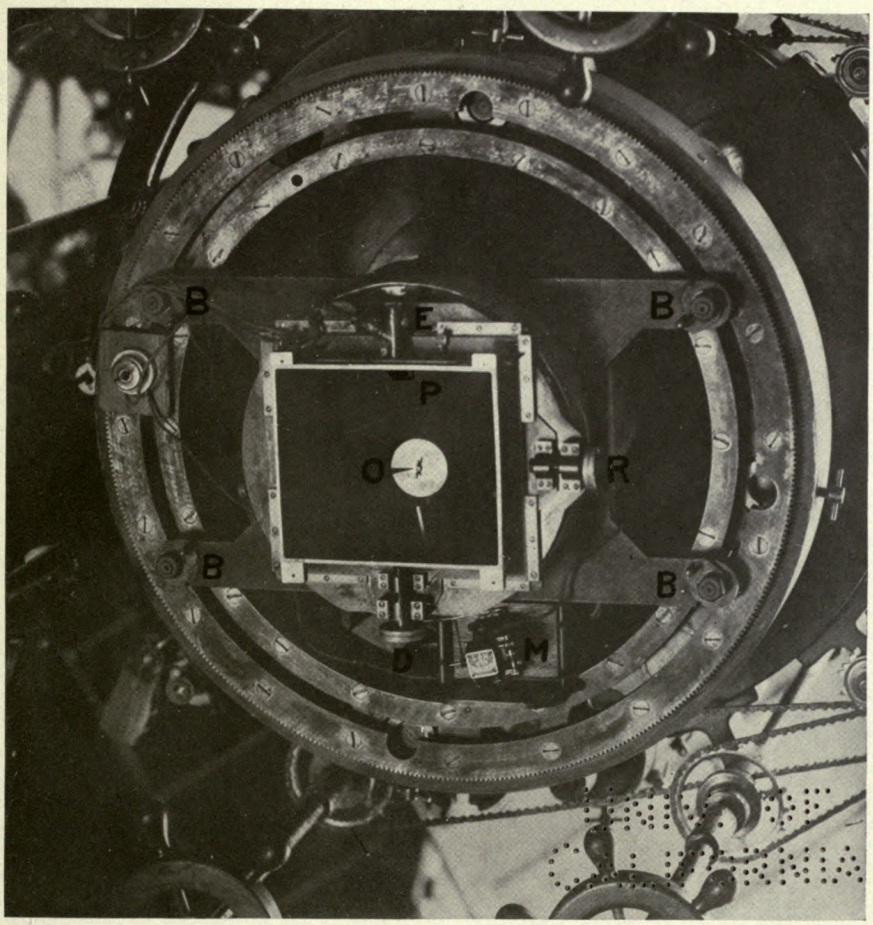
Early tests on the machine showed that measures could not safely be made nearer to the ends of the scale than 15 to 20 mm, because of one-sided illumination. To remedy this defect, the slit in the bed-plate was extended about 2 cm at each end and a new reflecting mirror was constructed and mounted beneath it. This extended the usable field to within a few millimeters from the ends. The first tests of the straightness of the V-way showed it to be very nearly straight except at the lower end. The machine-bed was accordingly sent back to the maker and was corrected by him. Although special tests showed conclusively that the V-way could not in our case have been deformed by removing the material in lengthening the slit in the machine-bed, it is of course possible in other cases, and observers are warned of this possibility.

The necessity early revealed itself of examining the machine carefully for small errors of assembling and final fitting of parts before making tests. Thus, in our case, a misplaced washer on the shaft for moving the plate-carriage prevented the carriage from resting fairly on the V-way. To remedy the same defect it was also found necessary to mill down one end of the rack under the plate-carriage. A slight scraping contact between the block, which carries the microscope, and the heavy bar beside it, on which is secured the millimeter scale, was eliminated by milling down the bar about half a millimeter.

A thin metallic shield, 21 cm long, was fitted over the block which supports the microscope to protect the screw from condensation of moisture and possible local thermal effects occasioned by the observer's breath.

A sensitive level, suitably mounted, proved to be very useful, in a qualitative way especially, for preliminary tests of the straightness of the ways. We used the level from our transit instrument. Mr. Georges Van Biesbroeck, visiting professor for 1915-16 from the Royal Observatory of Belgium, took part in the preliminary testing of the machine.

PLATE I



DOUBLE-SLIDE PLATE-CARRIER FOR 8×10 INCH PLATES AS ATTACHED TO YERKES REFRACTOR

P is a diagonal prism close to, and in front of, the photographic plate. *E* is the guiding eyepiece. *R* and *D* are the screws for moving the plate-carrier in right ascension and declination, respectively. *O* is the adjustable sector. *M* is the motor for rotating the sector. The *B*'s are the T-bolts which attach the whole apparatus to the telescope.

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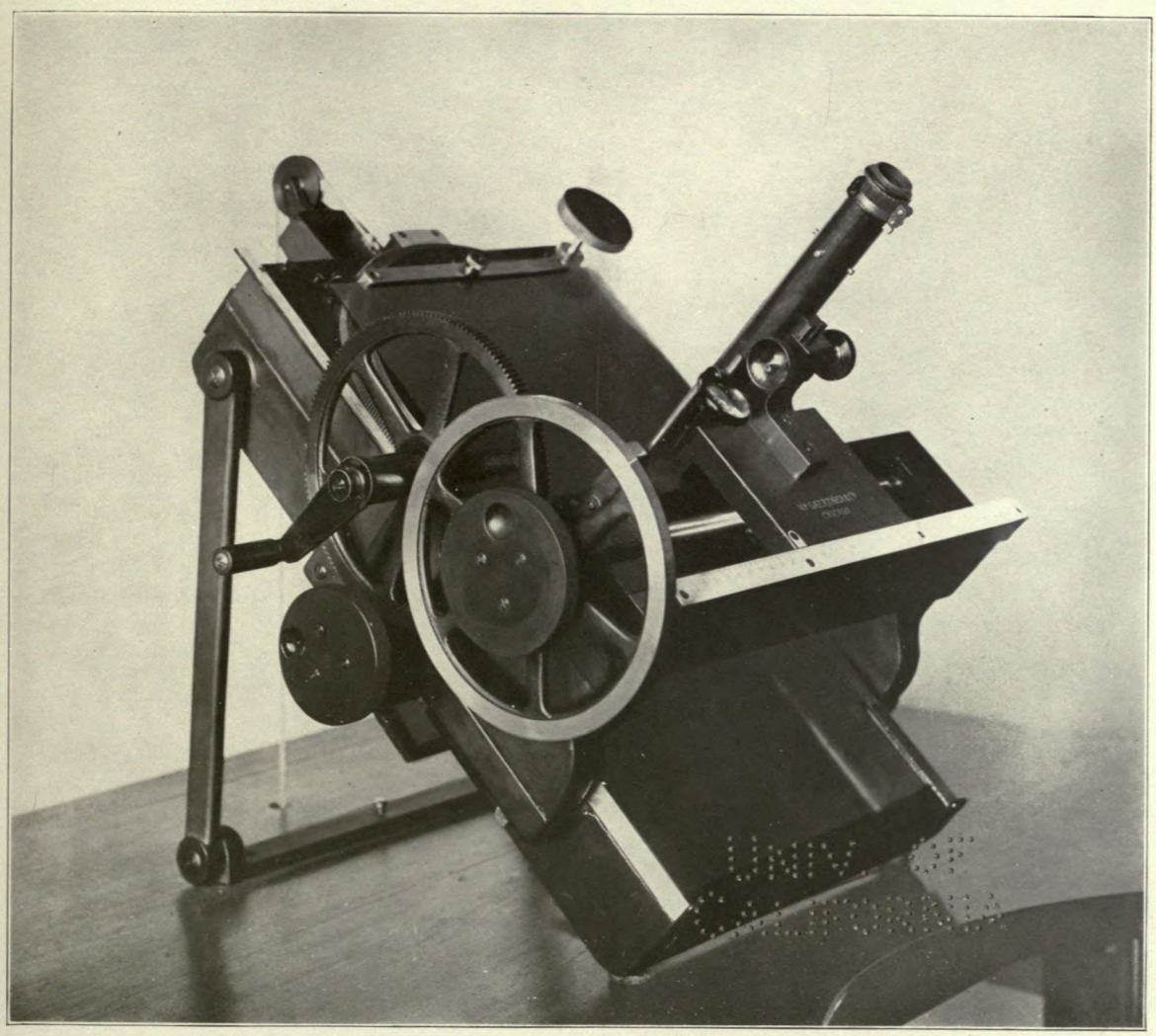
PLATE II



MEASURING MACHINE FOR ASTROMETRIC PURPOSES (By William Gaertner & Co.)

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